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CHANGES IN UNDERWRITERS' RULES.

In another column we give the result of the work of the Electrical Committee of the Underwriters' National Electric Association at its meeting last week in New York City, providing for a number of changes and additions to the present code of inspection rules of that body. Though the number of changes is quite considerable, yet none appear on the face to be of a radical character. One of the new rules to be particularly commended is that forbidding the use of cut-outs in canopies and bracket bases; judging from the holes one could so frequently see burnt in the former, it is high time that the practice was condemned. We shall be pleased to receive any criticisms on the changes, which will also doubtless be welcomed by the Electrical Committee of the Underwriters' Association. In asking the co-operation of the electrical public in determining what changes and additions in the inspection rules were necessary, a spirit of fairness was displayed which should, at least, be recognized to the extent of making specific criticisms of the rules and definite suggestions as to their improvement.

AUTOMATIC ELECTRICAL SYSTEMS.

The automatic electrical devices employed at the Boston Illuminating station for manipulating storage batteries illustrate how easily in many cases powerful automatic action may be secured, and how simply forces may be controlled, however great, by mere pressure on a contact or the throw of a small switch. Many applications of these principles have already been made to a greater or less extent, such as to the automatic closing of water-wheel gates, the automatic operation of railway signals and switches, the electrical steering of vessels, the manipulation of ordnance, etc. The Sprague electric elevator system also furnishes an admirable illustration of the successful application of electrical control from a distance, and there are doubtless many cases where its use would solve perplexing problems, or open up new avenues of usefulness. In large steel works a station called the "piano" controls by levers the movements of the convertors and ladles, the method of control used being entirely mechanical. There would seem to be here a field for an electrical "piano" based on the principle of electric relay control, and no difficulties would be met in the conditions existing with respect to amount of power requiring control and precision of action.

LOGICAL TREATMENT OF BOILER SCALE.

Boiler scale is a frequent cause of trouble, and is so variable in its nature that each case requires special treatment. It is one of the most popular errors among firemen to get the idea that a remedy is universal simply because it assists the particular case with which they are familiar. To intelligently combat with boiler scale, one must know of what it is composed. There are two classes of remedies, which accomplish exactly opposite results, the one being applied before and the other after, the water has entered the boiler. The latter remedies are usually those for which so much is claimed. Ingredients placed within a boiler to prevent scale should precipitate the foreign matter in a flocculent mass, which will be held in suspension, or they should unite with the insoluble matter, forming a soluble salt. It is obvious that no one reagent can accomplish this result with every salt that may be contained in the feed water, hence the absurdity of a universal remedy. The general rules may always be followed with profit. First, heat the feed-water in a settling drum and allow it to settle before feeding; second, blow down to the last gauge-cock frequently and pump up fresh. It is very often the case that patent boiler remedies are placed in the feed-water to precipitate

foreign matter, and then the water is immediately fed without a chance to settle. In such cases the remedy may only make the matter worse. It is always easier to scoop soft sludge out of a settling drum that to chip hard scale out of a boiler, and, therefore, if precipitation compounds are used, they should be given time to do their work.

LARGE RAILWAY GENERATORS.

In another column will be found a description of a large railway generator of 1500-kw capacity. The question naturally arises: How large will it be advisable to build such machines in the future, when steam traction will be partially or fully superseded? But little gain in efficiency over the direct-coupled 1500-kw machine is afforded by larger sizes. A full load at all times should be given such a machine, for it is ruinously extravagant either to let it stand still or to run it under light loads. With larger generating sets than 1500-kw, therefore, the problem is very similar to that of smaller generators, concerning which the same point has been raised. The limit set by constructional difficulties is so far ahead of our present manufacturing facilities as to make it negligible for many years to come. The problem, therefore, narrows down practically to the question of the minimum output which it may reasonably be expected the line will demand of the station, as it would obviously be uneconomical to use a unit much larger than necessary to carry the minimum steady load. The magnitude of this load will depend upon future developments, concerning which any prediction would be unsafe.

THE TROLLEY DECISION.

The decision of Judge Townsend, sustaining the Van Depoele fundamental patent on the electric railway trolley, was doubtless a considerable surprise to a majority of the electrical public. In view of the state of the art of conducting current to moving vehicles, which, prior to the day of the electric railway, had been well developed in attempts to accomplish railroad train telegraphy, it did not appear probable, on *à priori* grounds, that a claim so sweeping as one for a fundamental patent on the present electric railway trolley could be sustained, and a reading of the opinion of the court will not, we fear, convince skeptics of their error. The premises of the opinion seem to be, that prior to the Van Depoele invention no one had proposed to equip an electric car with a contact device mounted on the end of a long pole upwardly pressed by means of a spring, or to hinge such a pole to a car and make it turn upon a pivot; that, though each of the elements in the combination of hinged and pivoted trailing arm and the upwardly-pressed contact device had been variously described in earlier patents, yet other inventors than Van Depoele did not adopt, adapt and develop these devices; that the vital features of the problem of the electric railway trolley were both vertical and lateral movement, which of all of the early trolley patents, are provided for in that of Van Depoele alone; therefore, "When Van Depoele discarded the elevated wheel and springs of his earlier patent, and broke away from his own towed trolley and those of Siemens, Finney, Henry and others, and reversed the underrunning trolley of Edison and Daft and added lateral motion thereto; and went back to the overlooked art of animal tether, or to the limited and impracticable art of railway signalling, and selecting and combining certain elements of the various contrivances, modified and adapted them to a new purpose, and thereby disclosed to the public a practically operative means, such as the whole world of electrical railway inventors had heretofore sought in vain, and which has gone into universal use throughout the country, he made an invention within the rules applicable to this question." It will be noted that part of Van Depoele's invention is stated to have consisted in reversing the Daft and Edison trolleys, and elsewhere in the opinion it is remarked that even if these devices otherwise anticipated that in suit, they failed in the vital feature of not providing for capacity of universal movement. The above exceptions seem to reduce the features upon which the validity of the Van Depoele patent rests to the employment of a long, upwardly spring-pressed pole, to more readily provide for vertical variations in the height of the trolley line, and means to provide for its lateral displacement from the central plane of the car. In another part of the opinion it is stated that when one alone of several inventors successfully solves a problem, the solution of which all were seeking after, that fact furnishes strong support to the presumption of invention; and this failure of other inventors is elsewhere spoken of as presumptive evidence that invention was required in the conception of the Van Depoele device. It seems that several essential considerations have here been neglected which should be regarded if this criterion of invention is to be applied. In an early and chaotic state of the art, it can easily be imagined that difficulties may be encountered which later prove to be of the most obvious solution; or that prevailing opinion may lead inventors to seek a solution to a problem in directions departing widely from what subsequently proves to be the one fixed by the real conditions of that problem; or, that of those working at the same problem, one may succeed where the others fail, not on account of the possession and exertion of the inventive faculty, but through a clearer or earlier perception of the conditions to be met; or that, of a number of inventors, many may be so engaged on other problems connected with the same art, that but slight attention is given at the time to one that may be temporarily of minor importance, and their efforts with respect to it, therefore, perhaps only tentative. As the opinion states, Van Depoele early recognized the vital importance of flexibility in the trolley, but this, of course, would subsequently and in due time, have been universally demonstrated. This recognition should not, therefore, as the court seemed to think, be considered in the interpretation of the patent. It should rather be assumed that with the advance of the art this condition would have soon become apparent to all, and that, consequently, the question at issue is, whether the means adopted by Van Depoele would have then been obvious, and whether the action of the inventive faculty is implied in the solution his patent offered. No one, in any event, will deny to Van Depoele the great credit due him for the admirable way in which he met the conditions involved in the successful operation of the trolley, but this should be kept distinct from the question as to whether invention is present in the methods he adopted. That apparently startling results may be accomplished by obvious means in the first stages of an art should be an axiom more often present in the minds of the judges than it is, as well as the principle that comparisons between the work of different workers in an art at the same period furnishes an unsafe criterion. In conclusion, we will say that the criticism contained in the foregoing remarks is directed rather at the method of interpretation employed by the court than at the matter of the invention itself. The opinion, in fact, appears to leave the question where it was, if we subtract the inferences from the various presumptions to which we have referred. What the issue will be on appeal, therefore, cannot well be predicated from the present decision, unless we assume that the other judges will apply the same presumptive method of interpretation.

One of the Effects of Competition.

At the town of Ragatz in Switzerland there was such a keen competition between an alternating-current and a continuous-current water-power plant, for lighting the principal avenue of the town, that the result was the local authorities obtained the light from the continuous-current installation gratis.

The American Institute of Electrical Engineers.

The monthly meeting of the American Institute of Electrical Engineers, which was appointed for Dec. 18, was omitted by direction of the committee on meetings.

The Long Island Traction Company.

The property, rights and franchises of the Long Island Traction Company were sold at public auction at 1 o'clock on Friday, Dec. 13, in the real estate salesrooms at 111 Broadway, New York, to John G. Jenkins, of the Reorganization Committee, for $5,500,000.

The company was incorporated several years ago in West Virginia, and capitalized at $30,000,000. It owns all the stock of the Brooklyn Heights Railway Company, the Suburban Railway Company and the Brooklyn City Railway system. It was organized to change the motive power of the railway lines from horses to electricity. From the time it began quarrels between the stockholders have been numerous, and the company lost money. The climax of its reverses came with the big trolley strike of a year ago. Soon thereafter the old management got out, and ex-Gov. Flower took charge of its reorganization. He and his associates are back of the present plan of reorganization, which includes the reduction of stock of the company from $30,000,000 to $20,000,000. This will be accomplished through the exchange by each stockholder in the old company of three shares of stock for two shares in the reorganized company.

All of the street railway lines involved will be consolidated under the name of the Brooklyn Rapid Transit Company. Under the old organization the stock of the company was unassessable for taxes of any kind. The reorganization will be under the laws of this State, and the company will hereafter be subject to taxation here.

Another Projected Alpine Road.

Those who are acquainted with the beautiful district near the City of Interlaken, in Switzerland, will be interested to learn that a project, which will no doubt be carried out, is at present under consideration for constructing an electric mountain road from Meiringen to Grindelwald, over the Grosse Scheidegg. This completes the round trip from Interlaken through Meiringen to Grindelwald, and through the Lauterbrumen valley back to Interlaken, and passing in front of the famous Bernese Alps, it will be one of the finest railroad trips in the Alps. This new road will form the second line to reach the starting point of the electric line, which is at present under construction, to reach the top of the famous Jungfrau. The power for the new line will be obtained from the Reichenbach, which forms the famous Reichenbach Falls ; 2500 hp will be obtained, but, it is hoped, without destroying the beauty of that curious falls. The plans have been completed and the money secured.

Accumulator Traction Proposed in Brookline.

It is reported that the management of the Brookline Street Railway Company, recently organized, proposes to give storage batteries a thorough trial. The first equipment of the road will be 10 box cars and 10 open cars, snow plows, trucks, etc. The cars will be 22 feet long, and, it is said, will be the most beautifully finished. It is stated that a contract has been made with the Electric Storage Battery Company, whereby the latter shall operate the roads by means of its storage-battery system for at least six months to the satisfaction of the owners of the road, and that a forfeit will be put up large enough to cover all costs of the equipment should it prove a failure.

A Very Light Motor.

According to the *American Machinist*, a Kane-Pennington petroleum motor, weighing only 17.5 pounds gave 4.75 indicated horsepower when run at 700 revolutions and 10 horse-power at 2000! A speed of over a mile a minute was said to have been obtained with this motor on a bicycle. The inventor is about to experiment with the application of this motor to flying machines, some preliminary experiments having given very promising results.

Heavy Passengers.

It appears from a very carefully kept record of the Montreal Street Railway Company for a whole year, that the total weight carried per passenger is as much as 1.57 tons ; assuming the weight of a passenger to be 140 pounds, the "efficiency" of this system of transportation is 4.5 per cent. It may also interest riders to know that it takes about 1.66 pounds of coal to carry each of them one mile.

Changes in Underwriters' Rules.

Early in October, 1895, the Underwriters' National Electric Association sent out to electrical engineers and others thought likely to be interested in the subject, a circular letter with blanks, inviting such suggestions for changes or additions in the present underwriters' rules, supported by what seemed to be good and logical arguments for their adoption. A very large number of suggestions were received, and at a meeting of the Electrical Committee in New York last week were given careful consideration. At this meeting the discussions and votes were not confined to the members of the Electrical Committee, but the full privileges were extended to all present.

Chairman Cabot presided at the meeting, and in his opening address made a number of recommendations which subsequently were made the basis of a report by a special committee. The text of the report, which was adopted, is as follows:

That any increase of voltage on interior incandescent lighting circuits would result in a corresponding increase of dangers to life and property and that owing to the tendency toward the introduction of high voltages it be urged that extreme care be taken by inspectors and others in charge of such installations without which we believe serious hazard may be incurred; that the members of this committee and other electrical inspectors, here present, pledge ourselves to exert our influence to further the inforcement of the rules and requirements of the National Board of Fire Underwriters, and to cooperate with the Electrical Bureau of said board in furnishing that bureau with facts which come under our observation regarding devices and materials which may not be constructed in accordance with these rules, and the introduction of which would create a hazard to property.

That we further agree that all bureau reports received, setting forth such facts, shall receive careful consideration and the finding of the report be followed out as far as possible in our respective territories, to the end that co-operative work along these lines may be established and uniformity of action in all essential matters secured.

That the introduction of trolley wires in municipal districts is inimical to the safety of the property of the inhabitants of such districts, and that because of this fact all possible precautions should be taken by the managers of trolley roads throughout the country, to insure cutting the current off of the wires in case of fire in abutting property; also that trolley wires should be effectually protected against the possibility of contact between them and other conductors; also that trolley systems should be so arranged that practically no difference of potential due to the effects of trolley roads should exist between subterranean pipes.

The attention of the committee was called to the fact that storage-battery experts claim such batteries are extremely subject to damage by water in case of fire.

The Committee on Tests were requested to report a standard for iron or steel armored conduit which should meet the approval of the committee.

In accordance with suggestions from several sources, it was ordered that the definitions be incorporated in the rules themselves instead of being printed as an appendix. It was voted that the secretary advise all persons who sent in suggestions which were not adopted of the reasons given by the members of the committee for their rejection. The secretary was so instructed.

The changes made in the rules, while considerable in number, were not radical, except in a few cases, and the general class of work which now receives the approval of the underwriters under the present rules will not be greatly affected. It seemed to be the general opinion of those present that the rules were working satisfactorily, both to the insurance and electrical interests, and that only such changes should be made as were necessary on account of the progress of the electrical industry itself, or where experience had shown that additions to the present rules were required.

The following are some of the more important changes made, and are given in the order of the sections amended in the present rules :

The grounding of the frames of generators may be allowed when necessary by written permission. This change was made on account of the introduction of direct-connected and extremely large and heavy machines.

Switches for motors must hereafter plainly indicate whether the current is on or off.

Rules were adopted requiring wires to be protected from mechanical injury in buildings ; where necessary, high-potential wires by substantial boxing, giving a reasonable air space, and low-tension wires either by boxing or by an approved iron-armored conduit tubing.

It was ruled that the mesh of wire netting for arc light globes should not exceed 1¼ inches.

Switches on hanger-boards must cut out both poles of the lamp.

The use of wire smaller than No. 14 B. & S. will not hereafter be allowed except for pendant and fixture work.

The rules as to the construction and painting or filling of moulding were made more explicit.

The rules for special wiring in breweries, etc., will require that joints and splices be avoided as far as possible, and that switches in damp places be mounted on porcelain knobs so as to give an air space behind them.

It will hereafter be allowable to draw strings into conduits for the purpose of pulling in conductors, which should not be placed in the conduit until the mechanical work on the building has been completed as far as possible.

Hereafter cut-outs will not be allowed in the canopies or shells of fixtures.

Hereafter circuits must be arranged so that no group of lamps (whether on the same fixture or not) requiring a current of more than six amperes will be allowed to be ultimately dependent upon one cut-out, except that special permission may be given in writing for departure from this rule in case of large chandeliers.

Steps were taken which will tend to improve the character of double conductors, and hereafter, except for pendants and fixture work, a solid rubber insulation, protected by durable braid, will be required for flexible conductors.

Supports for motor ceiling-fans must have an insulator interposed between them and the motor.

The electrical requirements of the standard for barns and repair shops, as contained in the schedule now used by a number of rating organizations, are now to be incorporated in the rules.

Service switches must disconnect all of the wires entering the building ; that is, on the three-wire system, all three wires must be opened by the switch.

The use of brass-sheathed Interior Conduit and Vulca tubing will not hereafter be approved for bushings.

The use of incandescent lamps in series-circuits for decorative purposes will be allowed by special written permission, when installed in a proper manner.

Rules for electric heating apparatus were adopted, which will require, in addition to the general wiring being done, in accordance with rules, that the switches shall plainly indicate whether the current is on or off ; that the attachment of the feed wires be in plain sight ; that stationary heaters be treated as stoves, and that the flexible conductor necessary for use with flat-irons and other devices of a similar nature shall have an insulation that will not be injured by heat, such as asbestos, which insulation must be protected from mechanical injury by a substantial outer braiding.

The above constitute the principal changes in the rules.

The suggestion that the table of safe-carrying capacity for wires was too near the actual limit of safety was referred to the chairman of the committee for tests, investigation and reports.

The matter of obtaining more effective and more efficiently constructed devices for automatic safety cut-outs was referred to the committee on testing with a request that they obtain all the information possible in relation to the proper construction of fuse blocks, length of fuses and efficiency of fuse metal, and with relation to currents of various quantity and potential.

A committee consisting of Messrs. French, Goddard and Sweetland was appointed to consider and report on the question of how best to guard against the hazard due to the possibility of the breaking down of the insulation between the primary and secondary transformer coils. This subject was considered of importance, in view of the tendency toward extremely high voltages in long-distance transmission. The matter of preparing rules to govern marine wiring was referred to Mr. Sweetland for report. The subject of protectors which will obviate the hazard due to the liability of wires, such as telegraph, telephone and similar wires becoming crossed with electric light or power wires, was referred to a committee consisting of Messrs. Cabot, French and Merrill. The above committees will report at a later date.

Horseless Vehicles.

The *Engineering News* considers the term "motocycle" a literary abomination, and classes it with "electrocute" and "motorneer." It suggests, as a more proper general term, "motor wagon," and for special styles of the vehicle the terms motor cart, motor carriage, motor coach, motor phaeton, motor bicycle, motor tricycle, etc. The suggestion seems to us to be a very good one, and well worth following as self-explaining terms are always to be preferred to those whose meanings would have to be looked up in a dictionary.

Worm Gears for Elevators.

Discussing the use of worm gears for electrically-driven elevator mechanism, at a meeting of the Electrotechnischer Verein, of Vienna, Mr. Emil Kolben, of the Oerlikon Works, cited some efficiency tests recently carried out by Prof. Stodola, of the Zurich Polytechnic, with the ordinary double-thread worm-gear of the Oerlikon Works. The worm was 3⅛ in. in diameter, had a multiple-ring bearing, and engaged with a worm-wheel having 28 teeth, the wheel being of bronze, 14¾ in. in diameter. The whole of this gear was placed in oil in a cast-iron box. The gear was coupled to a 20-hp electric motor, and the braking tests were made on the worm-wheel shaft. At 1500 revolutions a useful performance of 21-hp was given on the brake, the efficiency amounting to 87 per cent. The speaker, who had previously conducted a series of experiments which agreed with the result above cited, expressed the opinion that the efficiency with the motor fully loaded will increase even beyond 80 per cent., if the following points are considered in the construction and fitting up of the gear for direct coupling with electric motors :

(1) The starting speed should, according to the output, amount to from 20 to 40 feet per second, instead of from 7 to 16 feet, as has hitherto been customary. This condition necessitates the use, not only of high motor speed, but also of a large diameter of worm, and consequently great distances between the teeth, powerful teeth, and ample bearing surface. By this means the total friction will be reduced. For the purposes mentioned the motors required range from 2 to 25 hp, with usual speed varying between 1600 to 800 revolutions a minute. As the elevator drums to be operated have speeds of from 150 to 40 revolutions a minute, it is possible to obtain in the most simple manner, without any intermediate gear, the whole speed reduction by means of worm gearing, with a single or double thread-worm having a ratio of reduction of 10 to 1 or 20 to 1.

(2) The mechanical production of worm gear requires the greatest care, if it is to be useful for the direct coupling of motors. The worm must be turned out of a solid piece of tool steel, and be tempered, smoothed, and polished. The crown of the teeth should be made of hard phosphor-bronze, and if of large diameter it should be drawn hot onto a cast-iron arm crown. The teeth are to be properly cut and polished. Gear constructed in this manner runs noiselessly, has only a slight wear, and a life of several years.

(3) In order to reduce to a minimum the friction of the whole mechanism on the starting of motors at full load, the pressure is taken up by starting discs arranged on both ends of the worm.

Electric Tanning.

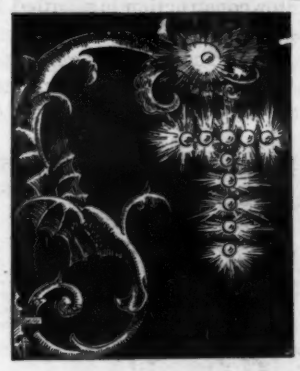
Since 1850, says the London *Electrical Review*, many attempts, chiefly of an empirical nature, have been made to accelerate the process of tanning by means of the electric current. Among the more scientific efforts which have been made in this direction is the system which has become identified with the name of Groth. In order to accelerate the Groth system, which has undoubtedly met with a measure of success, Folsing has recently suggested the use of extracts such as those of fir, quebracho, oak, &c., in place of the usual oak bark, these extracts having been previously purified, cleared and decolorized. He claims that this small modification will materially hasten the Worms and Balé process, which takes 48 to 144 hours for thin skins, as well as the Groth process, which may take as much as three months in the case of heavy oxhides. Folsing has also elaborated a further improved process suitable either for the tanning of thin or for thick hides, and which only requires from three to six days for the manufacture of the raw material into leather.

Briefly, it is as follows: The tanning pit has a capacity of 15,000 litres, and is about 80 inches broad and 10 feet long. Electrodes of nickeled copper are fixed to the longer walls of the pit, and in the latter the hides are so suspended that the current has to pass right through them, A current of 12 amperes with an E. M. F. of 12 volts is used. The tanning matter consists of oak extract with a little hemlock extract added, both of which are cleared and decolorized by a special electrolytic process. By these means Folsing states he succeeded in obtaining good leather in 72 hours from light cowhides, in five days from heavy cowhides, and in six days from heavy oxhides.

A Costly London Fog.

The London *Electrical Engineer* states that a certain November fog in London cost, in gas and electric light, accidents, delays and damage, $500,000.

New Features in Electric Advertising.



THE best advertisement is assuredly that which presents to the spectator the most novel effect. To show a thing as it has never been shown, to make a vivid impression upon the mind, to surprise the onlooker by presenting to his gaze something foreign to the ordinary course of his existence—these constitute the sum total of spectacular advertising. In the last few years electricity, because its inner workings are generally unknown to the crowd, has been a favorite medium in advertising. In fact, in many cases, it has been a trifle overdone in this direction, with the result of subtracting a bit of dignity from the science itself. But there are, on the other hand, many devices ingenious enough to call for special mention, and now that the Christmas season approaches, we begin to see them on all sides calling attention to holiday wares.

In the shopping district of New York City night passengers have noticed a very vivid representation of the American flag apparently waving in a blaze of light on the facade of a large department store on Sixth Avenue. Curious people stopping to look at this strange manifestation of Old Glory have been struck by the fact that the light surrounding the flag has not proceeded from its near neighborhood as might be supposed, but directly from the flag itself. Then the further fact was noticed that the stripes and field of the flag are composed of tiny electric lights which through some action gives the flag the appearance of waving in the wind. The stars, also, are composed of electric lamps. The whole effect is most novel, and the establishment has succeeded in obtaining a very good advertisement from the device. The flag, however, is only a part of the electric effects on exhibition on this building. The building itself is surmounted by turrets, and its roof is a series of peaks and cornices which lend themselves very well to electric decoration. The roofs of the turrets are fringed with rows of incandescent lights, and the various angles of the roofs have their quota. The front of the building also is decorated, and the turrets themselves contain several ruby arc lights which produce a strange effect when viewed from the sidewalk.

Generally speaking, all of the decorations except the flag are part of the regular equipment; the latter is the great wonder. It is made of wood, in two sections, the red and white stripes being painted in waving lines along the surface of the wood. The blue field is also painted, and each star is made of metal, in the centre of which is inserted the receptacle to contain the lamp. Thus, when the lamps

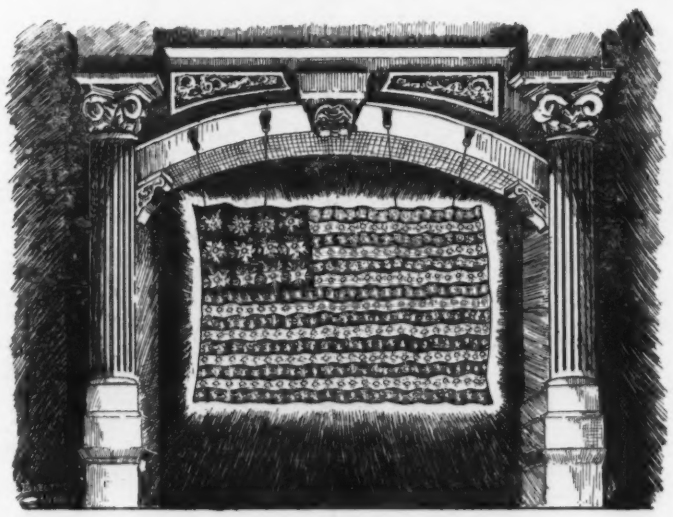


FIG. 1.—AN ELECTRIC FLAG.

are lighted, their light is reflected by metallic stars. Red and white lamps are used upon the stripes of similar color and they are controlled by a motor-driven switch which, when connected to the circuit, alternately lights and cuts out the lamps, giving the flag the waving appearance before mentioned. There are 425 lamps of 5-cp, each distributed over the flag, which is about six feet long and about four feet wide. The device has been exhibited with success at several G. A. R. encampments, where the character of the display aroused much enthusiasm.

As already mentioned, the rest of this particular establishment is well supplied with electric effects. There are over 5000 lamps in the building. Fifty 32-cp incandescents fringe the outer rim of each

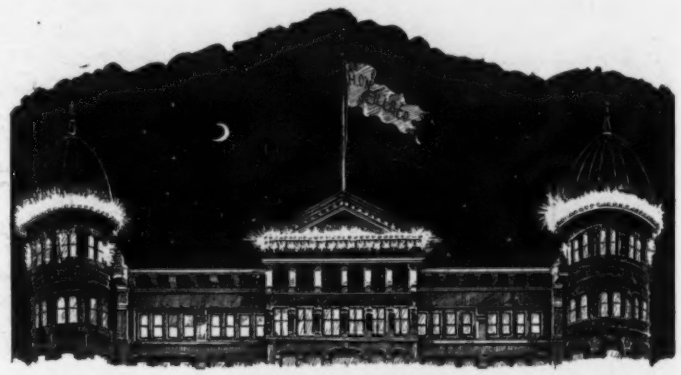


FIG. 2.—THE CORNICE DECORATIONS.

tower. There are fifty 16-cp lamps on the upper cornice, and there are two ruby arc lamps in each tower. Each of these arc lamps has a pane of red glass suspended directly above the globe to prevent the white rays of light from projecting upward through the aperture in the top of the globe. The result is the illumination of the white inside of the tower with an intense red glare. On special occasions there is a string of lamps placed upon the outside of the tower,

FIG. 3.—SALVATION ARMY BUILDING.

and the latter is lighted as far up as the pinnacle. The show windows have 400 lamps in each, arranged in such a way as to give a very good lighting effect for the goods inside. So it continues throughout the building. Every department has its full quota of lights, arranged in attractive form, and even the restaurant, which is draped in red, has a special arrangement of fancy electroliers and chandeliers, made to harmonize well with the artistic fittings

of the room. The whole equipment is supplied with current from the local Edison system.

The extremes of adaptability, as far as electricity is concerned, are well illustrated by placing the foregoing in contrast with the display made by the Salvation Army at its new building on Twenty-third Street. The building, which is the headquarters of the Salvation Army in the United States, is equipped from top to bottom with electric lighting effects, and the front of the building is illuminated so that the wanderer cannot mistake it. Every window has 56 lamps

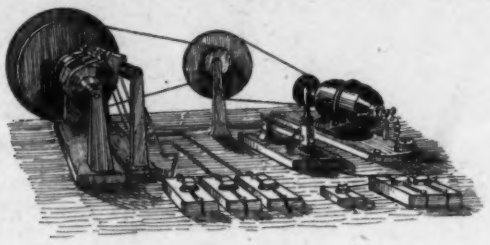


Fig. 4.—The Commutating Switch.

ranged round it, and in addition to this a huge transparency bearing the name of the organization extends up and down the front of the edifice. High in the air rises a huge tower, on which are grouped 100-cp lamps, and six arc lights situated at various points in the front of the building add to the general effect. The main auditorium has a seating capacity of 4000, and is brilliantly lighted by 500 incandescent lamps. The large lecture-room also has 500 lamps, divided up among nine combination fixtures and seven columns. The effect of the light on the column is very good, and the arrangement is said to have some symbolical meaning. The two galleries are bordered with 40 lamps each, and the effect of the whole installation is to produce a brilliant spectacle inside and out. Two Otis electric elevators carry the crowds to the galleries, and the further comfort of the multitude is assured by a hot-blast system which continually

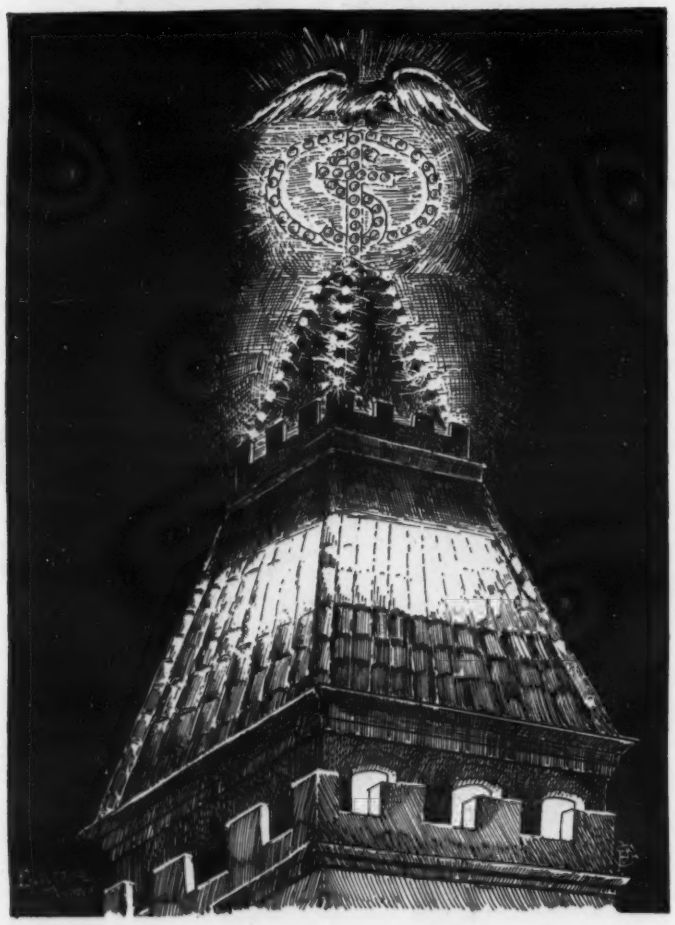


Fig. 5.—A Nearer View of the Tower.

changes the air within the building. The blower in the hot-air system is five feet in diameter and forces immense volumes of cold air from the outside directly between a number of heated pipes, which warm it during its passage. This blower is operated by a 7-hp motor. The switching system is well planned and provides a switch for every gallery passage and other separate division where lights are placed in the house.

A Large Railway Generator.

A fine example of substantial generator construction is afforded by a 1500-kw machine, which is now being built for the West End Street Railway Company, of Boston. The armature core of this generator is built directly upon the shaft of an Allis cross-compound engine; the shaft is two feet in diameter, and weighs something over 60

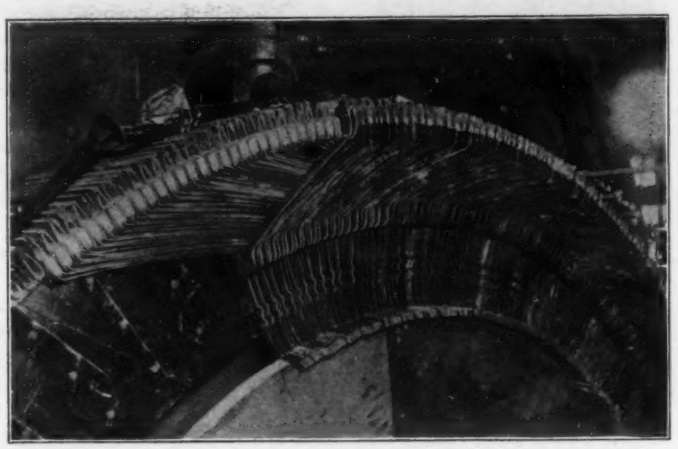


Fig. 1—Connector System.

tons. The diameter of the armature is 10 feet 6 inches, and its weight, with commutator, approximately 40 tons.

The armature core is receiving its windings while in position on the shaft. The core is built up of nine lammelar sections separated by eight brass spiders, leaving ventilating apertures at those points; each section contains about 210 sheets of soft charcoal iron. The core is provided with 696 slots, each of which contains two copper conductors insulated from the slot and from each other. The conductors are firmly locked in the slot by driving in a long wooden wedge above them, and the slots are liberally lined with fuller board and mica before the insertion of the bars, which are individually insulated with tape and mica. (See Fig. 2.)

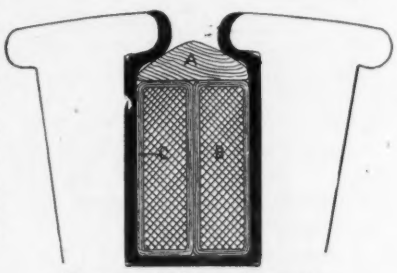


Fig. 2.—A Slot Section.

The rectangular copper bars are ¼ inch by ¾ inch, and are fastened to the connectors by a copper clamp, the joint being afterward sweated with solder. The peculiar shape of the armature tooth renders it next to impossible to dislodge a conductor either by magnetic drag or centrifugal force.

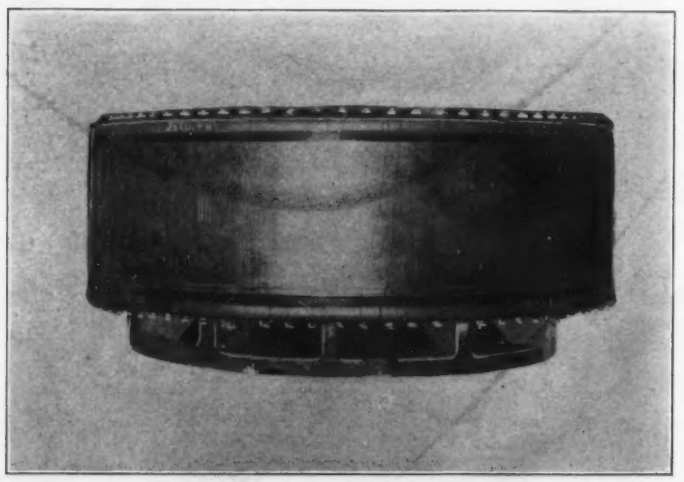


Fig. 3.—The Commutator.

The spiral method of connection is used on this machine, as may be seen in Fig. 1. The bars are usually inserted carrying the front connector already soldered on, and the rear connector is attached after the bar has been locked in position. The machine has 12 poles, and therefore the connectors partake very little of the spiral form, being only slightly curved. Two weeks are needed in which to wind the armature, one of which is required for preparing and insulating

the grooves. The clearance of the armature will be about ¼ inch. The armature is multiple-wound, and 12 sets of brushes are to be employed. The field magnet is to be of cast steel. The commutator, which is shown by Fig. 3, is a splendid piece of work, 20 inches across the face and 7 feet in diameter.

A general view of the set is shown in Fig. 4; it is interesting from a mechanical as well as an electrical point of view. The Allis cross-compound engine takes steam at 180 pounds, and expands in two cylinders 32 and 62 inches in diameter respectively. The stroke is 60 inches and the speed 75 revolutions per minute. The 73-ton fly-wheel is 24 feet in diameter and therefore has a circumferential speed of 5655 feet per minute. It is, however, substantially built to

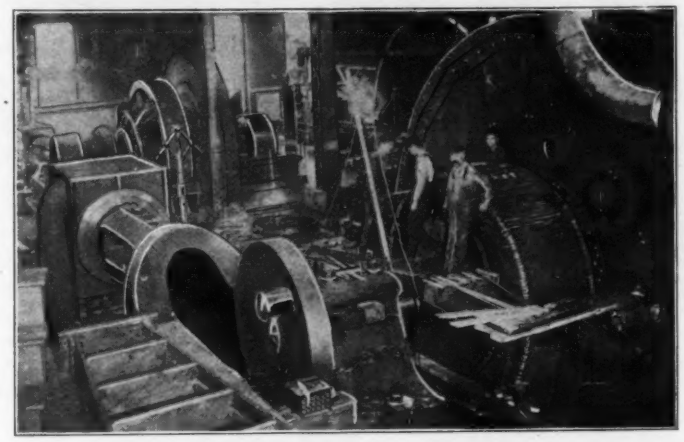


FIG. 4.—VIEW OF SET UNDER CONSTRUCTION.

withstand this stress, being made up of 19 1-inch wrought iron plates. The second and the eighteenth plates form webs going clear to the hub. The wheel is fastened together with 128 1¼-inch iron rivets and is composed of 69 web sections.

Storage-Battery Manipulation at the Boston Edison Station—II.

The automatic switchboard for storage-battery manipulation, which was described in these columns last week, is of a later design than the one which furnishes the subject of this article, but the latter is little, if any, inferior in either design or operation, and, indeed, may be considered to surpass the later board in some respects. It has been subjected to thorough tests over a considerable period of time, and has, without exception, proven entirely satisfactory in its operation.

In this board the travelers, which are mechanically very similar, and electrically exactly so, to those of the other board, are actuated by a screw instead of a reciprocating rack, as shown in Fig. 3. This

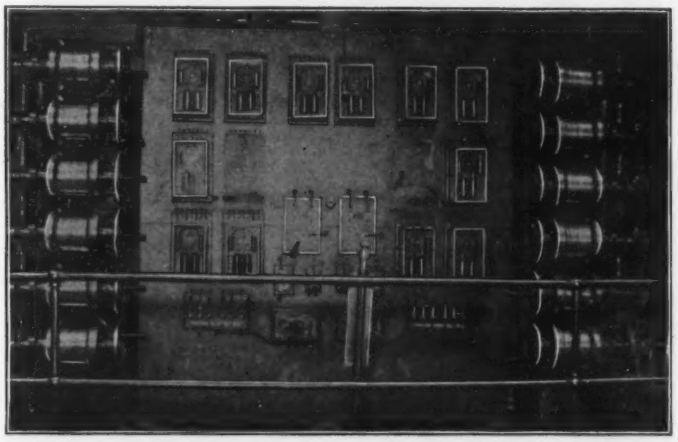


FIG. 1.—RELAY SWITCHBOARD.

screw turns either to the right or to the left, as the mechanism may direct, and gives the traveler a corresponding motion. Mechanical motion is given to the screw by two conical clutches, which turn in opposite directions, and are driven by an electric motor. By means of magnetic coils the portion of the clutch keyed to the screw spindle may be made to engage with either revolving part at pleasure. The oppositely rotating parts mesh into opposite sides of a bevel gear which is connected to the motor. One motor provides power for six clutches and their corresponding bus bars. The clutches are shown in Fig. 2, and a little inspection will render their construction perfectly apparent. It will be noticed that a hand wheel is provided in case the mechanism becomes disabled.

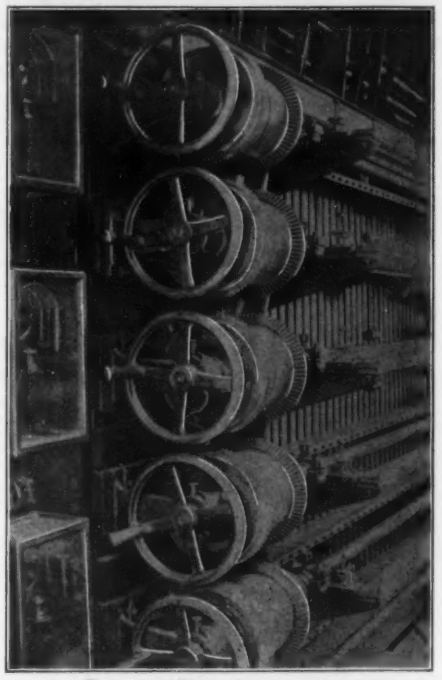


FIG. 2.—THE CLUTCHES.

The electrical operation of this apparatus is somewhat complex, but both ingenious and interesting. The connectors are shown in Fig. 4. The primary source of movement is derived from the double press button *X*, or the automatic relay, *A*, which may be connected to the pressure mains at any desired point. To take a specific case, suppose the switch, *A*, to fall on the lower stop, or, which is the same thing, suppose the left hand press button *X* to be momentarily closed. Current at once passes from the cells, down through *F* and the automatic switch, through one of the switch coils of the relay, *B*—for example, the left hand one. This causes the relay to throw its three connections on the left into their mercury cups. If now *X* be released, the circuit it has made will still be maintained as follows: Current flows from four cells through the cam switch, *E*, to the upper cups of *B*, and thence through the left hand coil back again. But *B* has also thrown two other contacts, which act in the following manner: From the battery comes a current strong enough to throw *H*, the motor switch, and start the motor; continuing it passes through the lower relay cups and thence through the right hand clutch coil, throwing the screw into motion thereby. The screw rotates past one cell, when the cam switch, *E*, opens the relay circuit, and both motor and clutch coil are at once deprived of current, for the normal position of the relay is as shown, and so maintained by springs. If the other button should be pressed, or the relay should act on the other stop, *B* would be

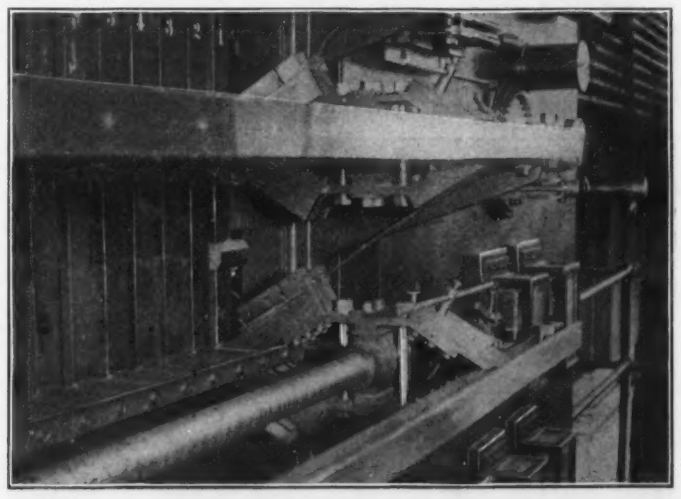


FIG. 3.—SCREW AND TRAVELER.

thrown the other way and the same action would take place, with the exception that the right hand clutch coil would act and the motion of the traveler would, therefore, be reversed.

The relay switchboard is shown in Fig. 1. The relay consists of two spools, each with a solenoidal plunger. These two plungers are connected by a cord, which passes over a wheel mounted on an axis; therefore, if one plunger is drawn down by reason of its coil

being excited, the other plunger rises. As the axis turns it carries with it three curved wires circularly bent around the axis as centre, which plunge their ends into mercury cups and thus complete the diagrammatic connections. The switch, *H* (Fig. 4), is a simple relay switch, breaking and making circuit at two mercury cups; *A* and *F* are two switches at the extreme ends of the travel, auto-

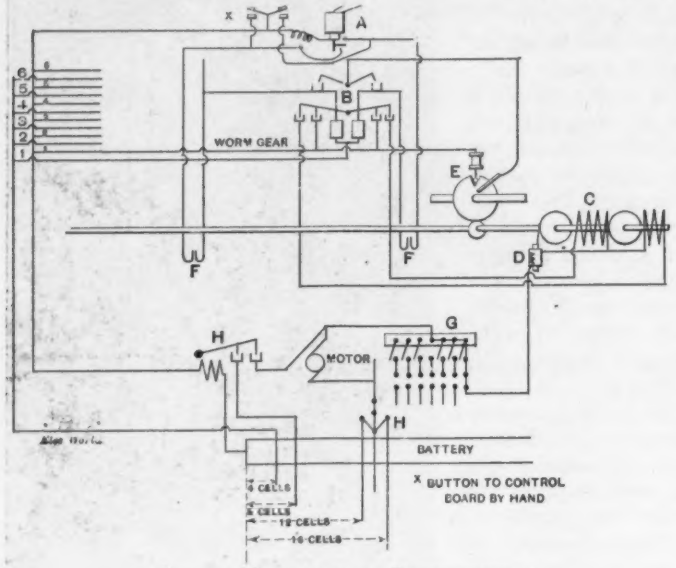


Fig. 4.—Diagram of Connections.

matically thrown by the traveler, so as to prevent further motion in either direction. The switch, *E*, was first broken by cam motion, but it was found better to fill the gap with insulating compound and break circuit in that manner. The relay, *A*, was intended for an automatic control, but its use was discontinued for two reasons; first, because the hand regulation of the dynamos did not well agree with the automatic regulation of the batteries, for the reason that the one regulation would continually chase the other; and second, because the traveler was liable to oscillate back and forth over a single cell, and thus short-circuit and buckle it. The board may be controlled either at the spot or at the controlling tower. With the exception of the instances named, the board has given complete satisfaction.

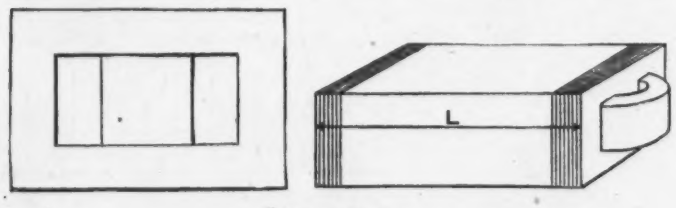
Notes on Transformer Design.*

BY GEORGE ADAMS.

As some obscurity appears to exist with regard to the best induction to employ in the iron circuits of closed magnetic circuit-transformers, the writer has made calculations for several sizes of transformers, as an attempt to clear up some of the points involved.

The following calculations and curves have been made for a 10-kw transformer, with the object of ascertaining the best working inductions. The transformer plates were of the type shown in Fig. 1, and were made of soft iron of good quality.

The induction was taken first at 1000 lines per square centimetre in



Figs. 1 and 2.

the iron core, the induction being advanced by equal increments of 1000 lines per square centimetre, until an induction of 6000 was reached.

In a transformer of this type the induction could be varied by reducing or adding to the number of plates forming the iron shell; accordingly, in the calculations which follow, it was assumed that the length, *L*, in Fig. 2, was varied in this manner from 12 inches to 73 inches, the dimensions of each individual core plate remaining unaltered.

The total losses in the iron were found to increase with the increased induction, while the losses in the copper circuits decreased with the increase of induction in the iron; this being due to the shorter length of wire required, and consequently diminished resistance of the copper circuits. The iron losses were calculated from the results obtained by Mr. Kapp in his experiments on transformer plates, the frequency being taken at 100.

The number of turns were supposed to remain constant, and were 272 turns for the primary circuit, and 14 for the secondary. The thickness of the plates which were tested averaged between .01 and .013 inch, and within these limits the thickness appears to have very little influence on the iron losses. The values given in the curves include both hysteresis and eddy-current losses. The iron losses in watts per pound, multiplied by the weight of iron in the iron core, gives the total loss in watts in the iron.

These results have been calculated and included in the tables below:

TABLE I.

Induction in lines per sq. centimetre.	Sectional area of iron in core. Square centimetres.	Net length of core in centimetres.	Net length of core in inches.	Gross length of core in inches.	Volume of iron in cubic inches.	Weight of iron in pounds.	Total iron losses in watts.
1000	1652.4	165.24	66'1	72.7	6345.6	1776.77	177.7
2000	862.2	82.62	33'04	36.34	3771.84	1056.115	211 2
3000	530.8	55.08	22'03	24.23	2114'88	592.167	236.87
4000	413.1	41.31	16'52	18.17	1585.92	444.06	275.3
5000	320.4	33 04	13'2	14.52	1267.2	354.82	312.2
6000	275.4	27.54	11'01	12.11	1065.6	298.35	363.08

TABLE II.

Induction in lines per sq. centimetre.	Length of wire, primary, in feet.	Length of wire, secondary, in feet.	Resistance of primary ohms.	Resistance of secondary ohms.	Loss in copper circuits, in watts.	Total losses at full load in watts.	Efficiency at full load.
1000	3754	194	5.77	.0147	291.25	468.95	.957
2000	2095	108	3.218	.0082	162.45	373.65	.964
3000	1524	79	2 34	.006	118.5	355.37	.965
4000	1279	66	1.96	.005	99.	374.3	.964
5000	1088	57	1.67	.004	81.75	393.95	.962
6000	1007	52	1.53	.0029	77.75	441.73	.957

Referring to Fig. 4, curve I. shows the iron losses at full load. Curve II. represents the copper losses at full load for both primary and secondary circuits. The total losses in iron and copper are

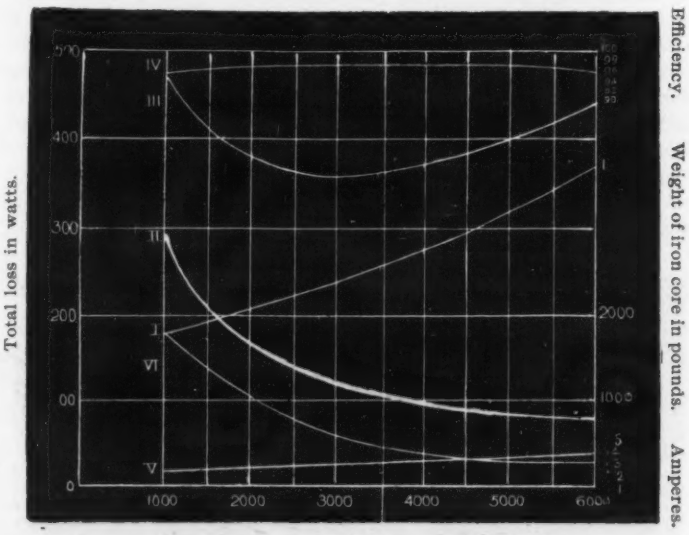


Fig. 3.

plotted in curve III, the ordinates being obtained by adding together the ordinates representing, first, the iron losses, and, secondly, the copper losses.

Curve IV shows the calculated efficiencies at full load, curve V the current at no load on secondary, and curve VI the weight of iron in the core. The abscissæ of the curve represent the induction in lines per square centimetre, while the ordinates give the beforementioned values of the functions of induction. The transforming ratio was taken as $\frac{2000}{100}$.

It will be noticed that the curve representing iron losses increases with an increase of induction, while the curve of copper losses decreases. By adding together the ordinates of these two curves,

* The London *Electrical Review*.

curve III, representing the total losses, is obtained. An inspection of this curve shows that the total losses have a maximum value at induction 1000; the losses then diminish as the induction is increased, until an induction of 2600 to 3000 is reached, and the total losses are a minimum at this part of the curve. Increasing the induction, the curve rises again, up to an induction of 6000. It is plain that the induction may be varied between 2500 to 3500 lines per square centimetre, without seriously affecting the efficiency of the transformer.

Curve VI gives the weight of iron used in the core of the transformer, and indicates the fact that the weight of iron diminishes with an increase of induction. The weight of copper used in the primary and secondary circuits also diminishes, on account of the reduced length of wire required. From considerations of first cost it is advisable to make the induction as large as possible. We arrive then at the conclusion that the best induction to work at, in order to satisfy the two conditions of high efficiency and low first cost, is from 3000 to 3500 lines per square centimetre.

We have next to consider the question of the no-load current, as this is a source of waste of energy, and should therefore be kept as low as possible. Between the limits of induction of 3000 and 3500, the no-load current varies from .31 to .32 amperes, so that the no-load current would not be much greater for the higher induction ; we might therefore safely work at an induction of 3500 lines per square centimetre. Although it would be injudicious to draw general conclusions as to the best working induction from the consideration of one particular transformer, yet some useful suggestions may be obtained from an examination of the curves and figures given. By constructing similar curves for transformers of various types and outputs, even general conclusions might be arrived at which would clear up some doubtful points concerning not only the best induction to employ in any particular case, but several other important items in the construction of transformers.

It may be safely inferred, however, that curves for other sizes and types of closed magnetic-circuit transformers would be of the same general nature as those given above.

The writer does not put forward these curves and figures as an illustration of the most economical form of transformer. It is quite probable that improvements might be made which would result in an increase of efficiency, and at the same time effect a reduction in first cost.

Frequency-Changing and Single-Phase Alternating-Current Motor Transformers.

BY LIEUT. F. JARVIS PATTEN.

There has been considerable of late in the electrical periodicals on the subject of changing-frequency; that is, of changing the rate of alternation of a single-phase alternating current and of breaking such a current up into two or more multiphase currents of the same or different rates of alternation. The writer, however, is surprised to find the entire subject treated as if it were entirely new and had never been worked out. As early as February, 1892, in a lecture before the American Institute of Electrical Engineers, I described apparatus for performing both these operations, which had then

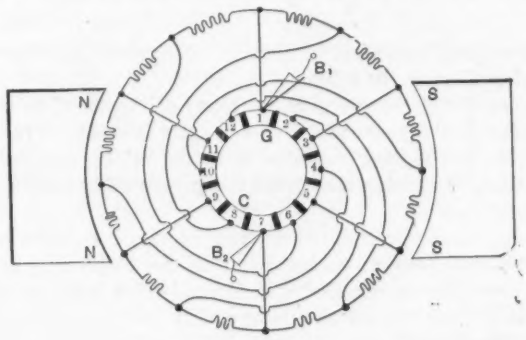


FIG. 1.

already been reduced to practice. These machines I designated as alternating-current motor transformers, their functions, however, being more varied in scope than those of the well-known motor transformer for changing the voltage of a direct or continuous current. The alternating motor transformers referred to, and of which I have since built several, could be made to change a singe-phase alternating current either to another of different frequency—or to a continuous direct-current—or to a number of equivalent multiphase currents. As I have made some advance in this direction since the lecture cited, it would seem *apropos* to explain the general system.

In his interesting contribution to the subject of two weeks ago, Mr. R. A. Fessenden gives a very succinct analysis of the losses inherent in any system of changing from a single-phase to equivalent multiphase alternating currents where the operation is dependent upon self-induction and capacity, as in the Bradley phasing transformers, and he concludes that a better method would be one in which the power is stored up in the momentum of a moving armature, and thinks it is not impossible to devise such a method.

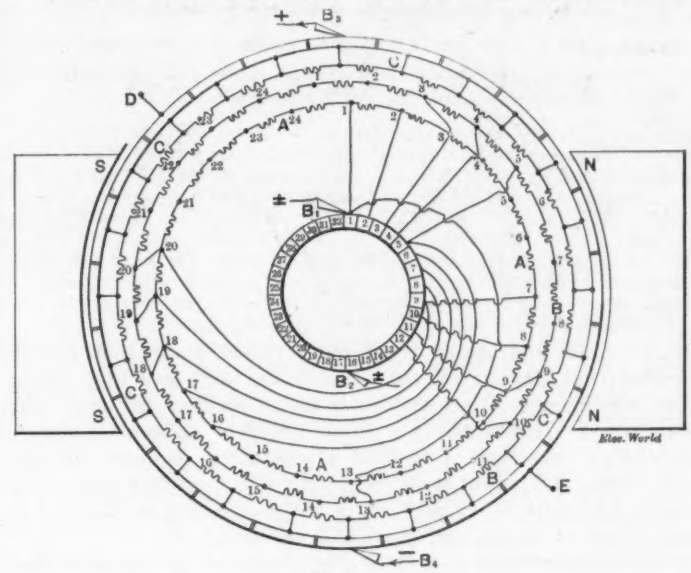


FIG. 3.

It is precisely such a method that I described nearly four years ago, and which I have since that time constructed in various practical forms.

The motor transformer grew out of an attempt to contrive a self-starting, single-phase, alternating-current motor. The armature connections of such a motor are shown in Fig. 1. It is an ordinary Gramme ring winding, with odd-numbered coils connected in the usual way, while all the even-numbered coils are connected in the reversed direction. Such an armature in a two-pole field, supplied also with the alternating current, will start itself and gain in speed until synchronism is reached—that is, until its speed is such that one segment or coil of the armature passes under a brush at each reversal of the alternating current. It will be noticed that when this occurs then both the positive and negative pulsations of the alternating current will flow through the Gramme winding in the same direction, owing to the reversed connections of the alternate coils, and the motor will be practically running on a rectified alternating current, which can be given to the field circuits as well by means of an additional commutator, not indicated in Fig. 1, but shown in Fig. 3, with the two direct current brushes, B_3 and B_4.

It is plain that we can connect such an armature for any desired synchronous speed; thus, if we have, say, 96 coils in the winding and segments in the collector. Then if we connected six segments direct, then six reversed, and so on, we would get a speed such that $96 \div 6 = 16$ reversals, or eight complete waves of the alternating current would correspond to one revolution of the armature, or with a frequency of 16,000 a minute, the synchronous speed of the armature at which the alternating current would become rectified would be 2000 revolutions a second.

A serious difficulty with such an armature in its simplest form, as shown in Fig. 1, is that the segments require to be spaced from each other so as to prevent the brushes bearing simultaneously on two successive segments, which would produce a short circuit from brush to brush through one, or at most two coils of the armature.

This effect is partially remedied, but not entirely when the coils are connected up in groups, but this case also requires a broad, separating segment between groups of direct and reversedly connected segments. In this case at best the entire armature-winding is momentarily cut out of circuit at each passage of the brushes, from one group to the next, and this is productive of bad sparking.

A different system of connections, which in a large measure overcomes all these difficulties, is shown in part in Fig. 3, and makes a good motor transformer system for getting other forms of current from a single-phase alternating current.

The armature has two primary windings, *A* and *B*, and a single secondary winding, *C*; this latter, being connected in the usual way to a Gramme collector, gives to the brushes, B_3 B_4, bearing on, it a uniform direct current.

The primary windings *A* and *B* are each connected up to the same

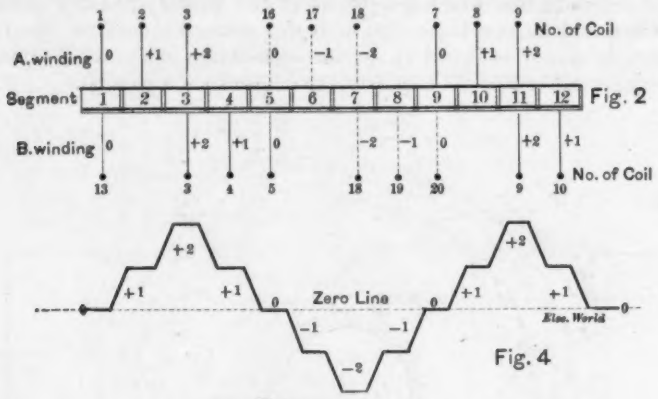


Fig. 2

Fig. 4

FIGS. 2 AND 4.

collector, in the alternately direct and reversed manner, previously described, but they are not connected in the same way to the same collector segments. Thus we have in the *A* winding (the inner one) coils 1, 2 and 3, connected as a direct group to segments 1, 2, 3, of the collector. Segment 4 is then a separating segment, not connected to the *A* winding at all. Segments 5, 6, 7, are then reversedly connected to coils 16, 17, and 18, of the *A* winding and so on; 8 is blank; 9, 10, 11, direct, and 12 is blank again.

Now the other primary winding *B* is connected in the same way except that in this winding corresponding connections are shifted one segment ahead so that the separating segments, or blank segments, of one winding are active or connected segments in the other; from this it results that when the brushes are on separating segments, they can neither cut the armature entirely out of circuit as before, nor can they short-circuit either winding.

The scheme of connecting the first 12 segments is indicated by diagram in Fig. 2, and is drawn in detail in Fig. 3.

In Fig. 2, the collector is represented as developed or rolled out flat, the segments being numbered from 1 to 12. The connections of the *A* winding are drawn above the line of segments, and those of the *B* winding are drawn down below this line, and when a coil is direct-connected its connection to the segment is indicated by a full line, and when the connection is reversed it is indicated by a dotted line.

In Fig. 4, projected below Fig. 2, the effect of this system of connection is shown by the diagram. Thus, when the alternating-current brushes, B_1 and B_2, Fig. 3, are on segments 1 and 17 respectively the primaries *A* and *B* are simultaneously connected to the incoming current, but one is direct and the other is reversed, thus producing zero result in the ring, as the flow through one primary is opposite in direction to that in the other, and this position should correspond to the period of zero current. On segment 2 the current goes direct through the winding *A* and none through *B*, so we have an effect in the ring which we may designate as + 1. From segment 3 we find both the *A* and *B* windings are direct-connected, giving an effect + 2. From segment 4 the *B* winding alone is direct-connected, giving the effect + 1, and from segment 5 we find the *B* winding direct and the *A* winding reverse connected, giving zero effect again. The respective current values then pass through corresponding negative values, making a complete wave, which is then repeated as indicated in the diagram, Fig. 4.

Now, from the secondary winding, *C*, we can obtain, in well-known ways, as a transformed equivalent of the single-alternating current supplied to the primaries, either a continuous-direct current from brushes B_3 and B_4 bearing on the direct-current collector; or, from rings connected to diametrically opposite points, *D* and *E*, of this secondary winding, we can take a single-alternating current having one quarter the frequency of that introduced to the primary windings. Of course, multiphase currents can be obtained from this secondary winding by simply tapping the winding at the required number of equidistant points.

Here, then, we have a motor-transformer system by which almost any desired form of current can be derived from a single-phase alternating current, and as the energy of the current supplied is stored in the momentum of the revolving armature, such a system ought to be comparatively free from the defects pointed out by Mr. Fessenden in his criticism of those systems that depend on self-induction and capacity.

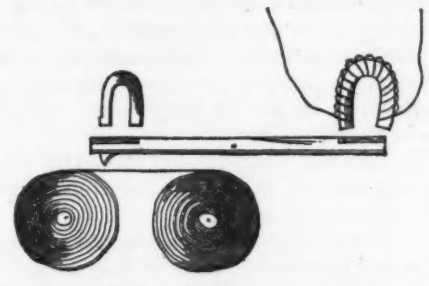
In the system here described the magnetic effects will be found almost constant, because, with a fluctuating or pulsating E. M. F., like that of a rectified alternating current, the magnetism does not fall to zero.

It is not merely the rectified alternating current that we get from the secondary coil, *C*, but a steady, continuous current generated independently of the current supplied to the armature to drive it as a motor. It is rather the direct current of a continuous-current dynamo, a dynamo that is not set in motion by a belt, but by using the same machine as an alternating-current motor to drive an independent armature.

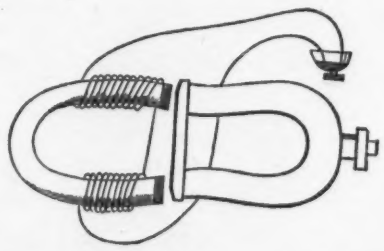
The Invention of the Electro-Magnetic Telegraph.—VIII *

BY MARY A. HENRY.

Let us now go on board the *Sully*. To Prof. Morse, in the course of an after-dinner conversation, has come the idea of the telegraph. The idea is original with him, but very many have had the same idea before him. In the days that pass before the *Sully* reaches the shore, while the other passengers idly pace the deck, he sits apart in the sunlight, making sketches in his note book. His biographer has shown what was in that note book, so we can look over his shoulder and see what he is doing. The machine he is contriving, we know



instantly, will not work at a distance, for look at the magnet drawn again and again. It is Sturgeon's magnet, with its simple loose coil, just as Morse saw it on Prof. Dana's table in that lecture in New York. It could be no other; *in 1832 there was no other electromagnet in existence* except Henry's, and of these Prof. Morse knew nothing. What is Prof. Morse preparing to do there on the deck of the *Sully* in 1832? He is preparing to repeat Barlow's experiment, and, like an echo, Barlow's words come to us: "I found such a sensible



diminution with only 200 feet of wire, as at once to convince me of the impracticability of the scheme."

The articles of this series give us many glimpses of what Prof. Morse is doing in the years which follow. He is making type, a port rule, etc., etc., a recording machine to be moved by electricity, but in all this there is nothing that gives the power to produce action at a distance.

Prof. Morse was appointed to a chair in the University of New York. Let us now mount to the room in the University building, where, in 1837, the instrument stands ready for inspection. Has Prof. Morse yet discovered anything which will make it work at a distance? We give his own account of it:

My first instrument was made up of an old picture or canvas frame, fastened to a table, the wheels of an old wooden clock, moved by a weight to carry the paper forward, three wooden drums, upon one of which the paper was wound and passes over the other two, a wooden pendulum suspended to the top piece of the picture or stretching frame and vibrating across the paper, as it passed over the centre wooden drum, a pencil at the lower end of the pendulum in contact with the paper, an electromagnet fastened to a shelf across the picture or stretching frame, opposite to an armature made fast to the pendulum, a type-rule and type, for closing and breaking the circuit resting on an endless band (composed

*Continued from page 647.

of carpet binding) which passed over two wooden rollers moved by a wooden crank and carried forward by points projecting from the bottom of the rule downward into the carpet-binding, a lever with a small weight on the upper side and a tooth projecting downward at one end operated by the type, and a metallic fork, also projecting downward over two mercury cups, and a short circuit of wire embracing the helices of the electromagnet, connected with the positive and negative poles of the battery and terminating in the mercury cups.

Look through all this list of articles; is there anything which gives the means of producing action at a distance? Prof. Morse has made a local type-writing apparatus to be moved by electricity, but has he provided the means by which electricity can be brought to it to work it at a distance? Look at the battery and the magnet. Dr. Gale gives us a glimpse of these:

In the Winter of 1836–1837 Samuel F. B. Morse, who, as well as myself, was a professor in the New York University, said he had a machine in his lecture room or studio which he wished to show me. I accompanied him to his room, and there, resting on a table a single-pair galvanic battery, an electromagnet, an arrangement of pencil, a paper-covered roller, pinion wheels, levers, etc., for making letters and figures to be used for sending and receiving words and sentences through long distances. . . . Morse's machine was complete in all its parts and operated perfectly through a circuit of some forty feet, but there was not sufficient force to send a message through long distances. At that time I was a lecturer on chemistry, and from necessity was acquainted with all kind of galvanic batteries, and knew that a battery of one or two cups generates a large quantity of electricity, capable of producing heat, etc., but not of projecting electricity to a great distance; and that to accomplish this a battery of many cups is necessary. It was therefore evident to me that the one large cup-battery of Morse should be made into ten or fifteen smaller ones, to make it a battery of intensity, so as to project the electrical fluid. Accordingly I substituted the battery of many cups for the battery of one cup. The remaining defect in the Morse machine, as first seen by me, was that the coil of wire around the electromagnet consisted of a few turns only, while to give the greatest projectile power the number of turns should be increased from tens to hundreds, as shown by Professor Henry, in his paper published in the *American Journal of Science*, 1831. After substituting the battery of twenty cups for that of a single cup, we added some hundred or more turns to the coil of wire around the pole of the magnet, and sent a message through 200 feet of conductors; then through 1,000 feet; and then through ten miles of wire arranged on reels in my own lecture room in the New York University, in the presence of friends. All these experiments were repeated with the original Morse machine, modified as I have stated, by increasing the number of battery cups and the number of turns of wire around the magnet.

In the light this quotation gives us, look now again at the apparatus before Dr. Gale has visited it. The magnet; it is unchanged since we saw it in that note book; it is the Sturgeon magnet with its few turns of uninsulated wire; utterly incapable of action at a distance, and the battery of a single pair of plates is a quantity battery, incapable of the projectile force to produce action at a distance. What is Prof. Morse doing? Simply trying, as we saw him preparing to do on board the *Sully*, the experiment of Barlow, and he has actually reached the old difficulty—the failure of the electric force we knew was facing him when we looked over his shoulder at the little pictures in his note book. He says: "Early in 1836 I procured forty feet of wire, and putting it in the circuit, I found that my battery of one cup would not work my instrument." Had he added a hundred cups the result would have been the same, that magnet would not have responded, and his machine would have still have refused to work through those forty feet of wire. It is Dr. Gale who is the good angel of the occasion, and what was his office? Metaphorically speaking, *to lift the machine and place it in Henry's galvanic combination.* When that was done, a finger touch closing the circuit could call the fairy of the telegraph from a distance to work the machine. Dr. Gale was made a partner. It required many and constantly new experiments to apply Henry's principles to the varying conditions of different distances.

The principle did not fail, and soon we hear that the telegraph is working easily through ten miles of wire; its success is secured. Prof. Morse's machine was ingenious, no doubt, but what was it? I repeat, a local type-recording instrument, to be worked by electricity if electricity could be brought to it; there was nothing in it to give power at a distance. The ignorant world gave to the machine the credit it should have given to the galvanic circuit in which it was placed. The machine served to introduce the galvanic combination. I have taken little interest in the conflicting claims regarding the instrument which have been presented in this discussion; my duty is simply to trace my father's footsteps: nor are these claims of importance as regards the telegraph; it is a fact that the machine they concern has been dropped for something more simple; it stands useless now, although justly honored, and has no longer a place in the telegraph.

The pleasant town of Princetown is about 40 miles from New York, and was then, as now, of easy access by the railways. When Henry returned from his European trip in October, 1837, he was much pleased to learn from Dr. Gale of the use which had been made of his researches, and that by means of them the Morse recorder had been operated through a length of five miles of wire coiled on a large reel. On the 13th of November following he was informed that a second similar reel had been employed with equal success, making ten miles in the circuit. Henry borrowed one of these reels for use in his induction experiments, and on returning it sent a copy of a recently published memoir to both Dr. Gale and Prof. Morse. The latter was at that time in Europe. On his return, in a letter addressed to Henry, April 24, 1839, he said, after expressing his pleasure that his spool of wire had been of use and his thanks for the pamphlet:

In the absence of Dr. Gale, who has gone South, I feel a great desire to consult some scientific gentleman on points of importance bearing on my telegraph. I should be exceedingly happy to see you, and am tempted to break away from my absorbing engagements here to find you at Princeton. In case I should be able to visit Princeton for a few days, a week or two hence, how would I find you engaged? I have many questions to ask, but should be happy in your reply to this letter of an answer to this general one: Have you met with any facts in your experiments thus far which would lead you to think that my mode of telegraphic communication will prove impracticable? I think you have pursued an original course of experiment, and discovered facts of more value to me than any that have been published abroad.

Henry replied from Princeton in a letter, dated May 6, 1839, as follows:

I am pleased to learn that you fully sanction the loan which I obtained from Dr. Gale of your wire, and I shall be happy if the results are found to have a practical bearing on the electrical telegraph. It will give me much pleasure to see you in Princeton after this week; my engagements will not then interfere with our communications on the subject of electricity. I am acquainted with no fact which would lead me to suppose that the project of the electromagnetic telegraph is impracticable; on the contrary, I believe that science is now ripe for the application, and that there are no difficulties in the way but such as ingenuity and enterprise may obviate. But what form of that apparatus, or what application of the power, will prove best, can, I believe, only be determined by careful experiment. I can say, however, that so far as I am acquainted with the minutiæ of your plan, I see no practical difficulty in the way of its application for comparatively short distances, but if the length of the wire between the stations be great I think that some modifications will be found necessary, in order to develop a sufficient power at the farther end of the line. I shall, however, be happy to confer freely with you on these points when we meet.

Prof. Morse went to Princeton to see the telegraph working there in exactly the same way that the telegraph works to-day, and any one knowing Henry would know how freely his questions were answered; and we may imagine how in the presence of the instruments he had made he explained his researches. A letter from Prof. Henry, his biographer says, was the most encouraging communication Prof. Morse received during the dark days that followed between 1839 and 1843, when Prof. Morse was vainly petitioning Congress for the means to carry out his project.

If Henry's knowledge and counsel was thus sought while the telegraph was as yet in contemplation, both were also desired when the project came to be carried out. In 1843, Prof. Fisher, who in the absence of Dr. Gale, was assisting Prof. Morse, wrote to Henry, explaining the method proposed for insulating the wires and laying the lines of the conductors underground, and asking advice as to the best method of wrapping. Henry replied from Princeton, April 17, 1843:

The greatest practical difficulty you will have to contend with, I should think, will be in the insulation of the wires. Twine is a partial conductor, and by making the surface sufficiently extended, lateral transmission will take place to some extent. The loss, however, on this account can only be determined by direct experiment. It will probably increase with an increasing ratio; first, on account of the greater surface of contact, and secondly, because electricity of greater tension will be required to send the current through the longer wire. In order to diminish the number of points of contact, it might be well to wrap around each wire—besides its continuous covering—an extra strand of coarse twine, with the several turns at a distance from each other.

When the line of wires was being laid between Washington and Baltimore, Henry, anxious to point out the importance of keeping the separate wires at some distance apart throughout the circuit, wrote to Prof. Morse from Princeton, January 24, 1844:

During the last vacation I occupied myself as usual with my investigations in electricity, and among other results I arrived at one, which I think, may have an important bearing on the success of the telegraph. It is this: while a current of electricity is passing through a wire, one part of the conductor is constantly *plus* to any

other part which succeeds it, the difference in the degree of the electrical state constantly increasing as the distance is greater. The maximum difference is therefore at the two ends; and when the two extremities of long wires are brought into near approximation, there is a great tendency in the electricity to cut across from the one to the other. This tendency is not due, as has been supposed, merely to the great resistance of the long wire and the cross-cut offering a less resisting channel, but the fact of the one being positive and the other negative, and the consequent greater attraction of the electricity in the one part for the unsaturated matter in the other. On reading your letter on the subject of the telegraph in the newspapers, I was struck with the idea that you had probably met with the very difficulty my researches have led me to anticipate.

The danger apprehended was realized, and Prof. Morse writes from Baltimore, February 7, 1844:

I have read your letter with much interest, and it has determined me to make you a visit on my return from New York, which will be the beginning of the week, perhaps on Tuesday morning, the 13th inst. I found the difficulty which you apprehended in the insulation of my wires, but this I will explain when I have the pleasure of seeing you.

In this interview Henry advised Prof. Morse to suspend his wires through the air on poles, as he feared that the risk of cross-cutting on long lines, even with good insulation, was scarcely avoidable. Prof. Morse, who had thought of this method before, but with distrust, determined to carry it out, and early in the following month made preparations for its execution. Prof. Morse seems to have stopped again to see Henry on his return to New York, March 1. On the 24th of May following the first message was sent over the completed telegraph line from Washington.

The "relay" was not in Prof. Morse's first application for a patent, and when interrogated in regard to his means of continuing the line of the telegraph, in the case of "B. B. French and others *vs.* H. J. Rogers and others," he said:

If by the question is sought the date of my invention of breaking and closing one circuit by another, I answer in 1836. I exhibited the same in operation in the Spring of 1837. If by the question is sought the date of my invention of a short circuit, to be used at the extremity of the line, I answer in May, 1844. If by the question is sought the date of a still greater improvement, to wit, that of placing short circuits on the margin (so to speak) of the main line, all of them to be operated simultaneously, I answer that the idea of such an improvement first presented itself to my mind in the beginning of the year 1844.

Before the close of the year 1836 the device of opening one circuit by means of another, had been explained and illustrated by Henry several years, to exhibit how much power might be excited at a distance, to his class of Princeton students; in April, 1837, when he explained the device to Wheatstone, it was an old story to him. The device of calling one circuit into play by means of another is equally applicable to an intensity or a quantity combination. The especial use of the intensity combination to continue the line did not occur to Henry. As to the short quantity combination used in May, 1844, the necessity of that is suggested in the letter to Prof. Morse of May 6, 1839, and it must have been exhibited and explained to Prof. Morse when he went to Princeton to learn all that could be learned from Prof. Henry in regard to the telegraph. The further improvement, as Prof. Morse calls it, of opening several circuits simultaneously, seems to me only a continuance of the same thing; it was just as easy to open a dozen as one, but perhaps I am wrong. The idea is certainly very ingenious and was not Henry's. The important thing seems to me to be the device of opening the one circuit by means of the other; the uses to which it was applied being of secondary consequence, although these also are important.

Now that apparatus has nothing about it more than was in Henry's Albany telegraph of 1831; nor could it operate if it omitted any one of the inventions singly or together which were then for the first time combined. It depends entirely upon the discoveries made by Henry before 1831; and it could not have existed in the world earlier than those discoveries by the use of any means then known to man; nor since by any other means than those discovered by Henry.

Henry used a bell as a sounder; they now use a metal bar and sounding box. Henry reversed the battery current, whereby no spring is needed to withdraw the armature for the purpose of vibrating it; and that is the common custom in English and German telegraphs. Here they generally merely interrupt the circuit and the armature is withdrawn from the magnet by a spring; although Henry's device is also used here largely, and is essential to the quadruplex instruments.

If, however, the telegraph line is a long one—it may be a 1000 miles or more—then you will see two sets of Henry's spools, and two batteries. One is the "intensity battery and spool" first described, and the coil of fine wire may be and often is several thousand feet long, while the battery is composed of more than 100 cells. The distance being so great, they do not attempt to send force enough through the intensity-circuit to operate a sounder, but only to open and close the local circuit of Henry's quantity-battery spool; that circuit consists of a battery of but one or two cells of large surface, and a spool with about 100 feet of coarse wire wound about its core. The intensity-combination opens and closes this quantity circuit, whose armature strikes the sounder just as the intensity-armature itself does on a shorter line. This obvious plan Henry described and exhibited in Princeton to his classes before any magnetic telegraph was ever commercially constructed, or the convenience of such an arrangement had resulted from the great length to which the lines had been stretched.

Let us now consider what would have been the position of Henry in the world if at a time before his inventions had been so long in public use that he had lost his rights, he had taken a patent for

Firstly. His magnetic spools pure and simple.

Secondly. The combination of a magnetic spool of long fine wire with an "intensity battery," for the purpose of producing a practical magnetic effect at great distances.

Thirdly. The combination with such an apparatus of a quantity battery, operating upon a spool-magnet of coarse and short wire, at a distance from the intensity battery; whereby the great lifting power of the quantity magnet might be controlled by the intensity combination.

And *finally*, the combination of the intensity battery and spool, with a vibrating armature, so arranged as to strike a sounder when the circuit is closed or opened at the sending end, for the purpose of transmitting intelligible messages telegraphically.

All these he might have patented in the United States at any time during several years after his discoveries and inventions were made, and . . . if he had taken such a patent as late as 1837, he would have controlled the telegraph in this country, certainly until 1851; and unless he had been adequately rewarded for his great inventions his term would have been extended till 1858. Imagine the good he would have done to science if the wealth which this would have produced, been poured into his purse.

Mr. Edward N. Dickerson was one of Henry's pupils in Princeton. I end my story with the closing lines of a letter recently received (of Nov. 18) from the Hon. John P. Stockton, who was also a member of his class:

I cannot answer your letter without expressing to you the great affection as well as admiration I had for your father. He was the most simple-minded searcher after truth in every direction that I ever knew, and I think the most interesting and noblest character that I ever met in all my life.

It must have occurred to him at times, when he saw the fruits of his labors enriching the world, that he might have taken some share of the wealth; but he would not taint with selfishness the generous gift.

In those years, between the days on the *Sully* and the day when his machine was first exhibited, Prof. Morse was busy with something else than type and port-rule and ribbons of paper. He was, with infinite trouble, preparing that alphabet which now, in alternate sound and silence, spells out the message of the telegraph. It was intended to be employed with the dots and lines on his ribbons of paper, but its use has been much more enduring; we look in vain to-day for type ribbons and port-rule. They have vanished from the telegraph, but the vibrating bar and metal sounder which have replaced them are equally dependent upon this means of interpretation; without it the sounds they make would be like the inarticulate ejaculations of a child. We cannot do without the alphabet of the telegraph. This adjunct—it can hardly be called a part of the telegraph—is an invaluable gift, and cannot be too highly appreciated.

It seems to me the friends of Prof. Morse make a great mistake in claiming for him the invention of the telegraph. In the first place, the expression is a curious one in regard to something which was the object of years of long and unavailing effort attained at last through many discoveries and inventions. A claim may be made for the invention of this or that thing in the telegraph, but to call the whole an invention seems hardly to be using an appropriate term. Then upon what is the claim founded? Upon *an idea*, held by many before, and which alone can hardly be called an invention, and a machine found not essential to the telegraph, and which no longer finds a place in it. To press the weak claim seems to weaken the great claim which Prof. Morse has upon public gratitude, and what a great claim it is! *The introduction of the telegraph!* It has not even been noticed in these articles. It is, in fact, a difficult thing to realize what a tremendous thing it was to introduce at that time such an apparently chimerical affair as the telegraph. In Europe a half a century would not be very long ago, but ours is a young country, and in growing youth how great are the changes between the child and the man; the college student of twenty forgets how he felt as a schoolboy of ten. To introduce a new thing now is comparatively easy—in fact, we court novelty—we may soon see without surprise vessels passing to and fro in the air above us. In that day any new thing was regarded with distrust. We are so familiar with the telegraph that we must try to realize what a wonderful thing it is before we can imagine how it must have appeared as a new

thing. There was not only the discouragement of want of faith in the project, there were those weary seven years of unavailing efforts to obtain from Congress the necessary means to carry out the project. When this was accomplished came those innumerable practical and unforeseen difficulties which always meet the pioneer in a new venture—difficulties to be overcome only by constant ingenuity, wisdom, boundless courage and perseverance—until at last the telegraph, no longer confined to teaching a class of college youths, stretched from city to city, adapted to the commercial uses of man. Prof. Morse as the introducer of the telegraph cannot be too highly prized, or can too many statues rise to his honor. I would bring my hands full of fresh leaves for his laurel crown; but it should not be forgotten that, without Henry, Morse would have had no telegraph to introduce.

A few words I must say in regard to Henry's conduct in respect to the telegraph. He was frequently urged by his friends to take out patents for his magnets, his telegraph apparatus, etc. He invariably refused on the ground that he did not consider it compatible with the dignity of science to confine the benefits which might be derived from it to the exclusive use of any one individual. When the telegraph is at last taken up to be introduced there is no selfish predilection for his own system of signaling; in fact, his freedom from self-regard blinds him to its especial adaptability to the needs of the telegraph. He immediately welcomes Prof. Morse's machine, and endeavors to aid it in every way in his power. Such words as "the unfortunate controversy between Henry and Morse" have been used, and others of similar import. He was so averse to controversy of any kind that even in placing this article in this discussion I am troubled by the fear that I may be doing what may still be unpleasing to him. When Vail's book appeared without a notice of his contributions to the telegraph, he protested, but receiving for answer that, if he would communicate the cause of complaint, redress should be made, he held his peace, considering the answer worse than the offence. Mr. Pope—the lamented Mr. Pope—thought that in this he acted with less than his usual courtesy, but suppose that in the history of the Revolution Gen. Washington's services were left out, and that when he remonstrated the writer replied: "If Gen. Washington will tell us the cause of offence, I will repair it!" A dignified silence could be the only response. But this is a small matter. He made no further claim for consideration in the matter of the telegraph until forced as a witness to tell what he had done in regard to it.

In thus collecting together the facts of my father's connection with the telegraph, I have been telling a story so oft-repeated that it may seem tedious to many, but while my father has met only respectful consideration due him in these articles, in view of certain omissions, the story has not seemed unnecessary. As a resumé now in closing it I cannot do better than quote from Mr. Edward N. Dickerson, the eminent patent lawyer:

Come with me now into a telegraph office, and let us see what we find there. If the line be a short one—say 30 or 40 miles—you will see but one of Henry's spools fixed to a table, having a piece of iron, called an armature, capable of vibrating in front of its poles and so arranged that when the "spool magnet" attracts it, it will vibrate and strike a sounding bar of sonorous metal, which gives out distinctly the sound of the tap. The "spool" is wound spirally in layers with several hundred feet of fine copper wire, covered with silk in the manner specified by Henry in *Silliman's Journal*. At the other end of the line is a battery, composed of a number of cells in series, called by Henry for distinction an "intensity battery," and the wire circuit is supplied with a simple device, so that it may be opened or closed by the operator's finger. When he closes it a current of electricity flows from the "intensity battery" along the wire and around the coil of the "intensity magnet," and the armature strikes the sounder and gives the signal. The listener hears it, and as the order or the taps progresses, in accordance with pre-arranged artificial code, to express the letters of the alphabet by combinations of successive taps, . . . he hears letter after letter tapped out and the message is understood.

Motor Rheostats.

To the Editor of The Electrical World:

SIR:—Referring to the communication from Mr. H. Ward Leonard, which appeared in your issue of the 7th inst., I fully concur in what Mr. Leonard says regarding the necessity of a more general knowledge of the difference existing between motor speed-regulating rheostats and motor-starting rheostats.

The statements Mr. Leonard makes are, however, evidently from a theoretical point of view. In the third paragraph he states "if, for example, on a 500-volt circuit the motor was running at one tenth its full speed, the rheostat must have a capacity to absorb the full-rated current of the motor and have upon its terminals nine tenths of the E. M. F. of the supply circuit." In practice this is not true, as tests show that under these conditions the difference of potential at the terminals of the rheostat will be from 76 to 85 per cent. of the E. M. F. of the supply circuit, according to the efficiency of the motor.

In the fifth paragraph of his letter Mr. Leonard departs from his subject and makes some deductions from the published description of a certain motor speed-regulating rheostat which are apt to mislead the public as to the facts. "For example, a certain motor speed-regulating rheostat is described as having a length of 20 inches, a width of 15 inches and a depth of 21 inches." This describes, *so far as outside dimensions are concerned*, the 50-hp speed-regulating rheostat of a well-known manufacturer. "This rheostat would go inside a cubical body having a surface of 2000 square inches; . . . the surface of the cube represented by the dimensions of the rheostat must continuouly dissipate energy at the rate of 20 watts per square inch." An inspection of this rheostat shows that it is built up of seven corrugated plates, each 20″ x 15″ x 2″ with a clear air space of one inch between the plates. Each plate has a radiating surface of 1026 inches; a total of 7182 inches for the whole rheostat, instead of 2000 assumed by Mr. Leonard. "In operating an ordinary motor with the speed at about one tenth of its full speed, the watts which this rheostat must continuously dissipate would be about 40,000." A 50-hp motor of 90 per cent. efficiency while delivering 37,300 watts at the pulley is absorbing 41,445 watts. Deduct from this, say, 750 watts, used in exciting the field, and we have 40,695 watts absorbed in the armature. Of this amount, with the motor running at one tenth its full speed, the speed-regulating rheostat must have capacity to absorb about 83 per cent.; namely, 33,777 watts. In this case the rheostat in question must continuously dissipate energy at the rate of about four and seven tenths watts per square inch, instead of the 20 watts which Mr. Leonard's figures would give.

In motor-starting rheostats, on account of the abuse to which this apparatus is subject, it has been found good practice to specify 30 per cent. of the radiating surface required in a speed-regulating rheostat.

WESTFIELD, N. J. GEORGE L. COLGATE.

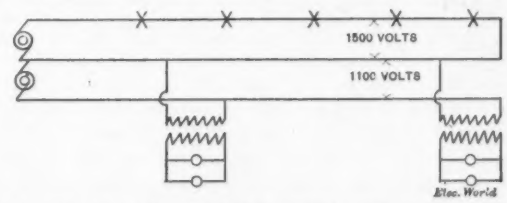
Central Station Supply Under Difficulties.

To the Editor of The Electrical World:

SIR:—In your issue of Dec. 7, it was stated in the latter part of an article with the above caption that both an alternating and direct current was sent over an ordinary three-wire system of distribution, and that no difficulty was experienced.

The writer successfully tried the same experiment some three years ago at a central station in Brunswick, Me., using 1500 volts direct and 1100 volts alternating.

The connections between the two machines, which were a Brush arc and a "National" alternator, were made like the following:



It has been truly stated that this could not successfully be done, from the fact that the current from one machine would at times be likely to flow through the armatures of the other.

This experiment was tried under severe conditions, but both lights and machines seemed to work very smoothly. BENNIE O. ELLIS.

RAHWAY, N. J.

Polyphase Currents from Simple Alternators.

To the Editor of The Electrical World:

SIR:—The article in your issue of Dec. 7, showing a simple and useful method of obtaining two-phase currents from ordinary alternators, states that three-phase currents may be derived from the two-phase by special transformers. A point that is frequently overlooked in this connection is that three-phase currents may be derived directly from two single-phase machines. If two such machines of equal voltage are rigidly coupled in such a way as to give a phase difference of 120° and connected in series, a triangular three-phase system is formed with equal voltages between any two of the mains and the same phase difference all around. The other or "three-branch" system may be obtained from this with ordinary transformers.

NEW YORK. J. E. WOODBRIDGE.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Behavior of Transformers at the Instant of Switching On.—Mr. Hay, in the Lond. "Elec.," Nov. 29, states that whatever rise of pressure may take place at the primaries on breaking the circuit when the secondary is open, it is highly improbable that the potential can ever rise above its normal maximum at the instant of switching on the transformers; experiments by Dr. Fleming and others have shown that there is no such rise. He believes there is a confusion between the current brushes and rises of pressure; for the latter there seems to be no reliable experimental evidence, and it is very doubtful whether they ever occur at the instant of switching on; it is absolutely certain, however, that enormous rushes of magnetizing current may occur without the slightest effect on the primary potential difference, hence devices to prevent this are altogether unnecessary, as these rushes are quite harmless.

Theory of the Non-Synchronous Motor.—An article by Mr. Goerges is begun in the "Elek. Zeit.," Nov. 28. The theories of non-synchronous motors which have been given by a number of writers, he claims, are not sufficiently clear regarding the magnetic phenomena, and therefore do not explain sufficiently well the "surprising" action, especially of the single-phase motor. They take into account the coefficients of self- and mutual-induction of the two windings, which can be considered as magnetism; but in a motor there is always only a single magnetism, which is the resultant. The method of starting with the resulting magnetism and then developing the two component parts has simplified the theory of transformers quite appreciably. Its application to motors was first made by Potier, but the present writer independently worked in this direction and arrived at the theory, which he explains, and which, he says, gives exceedingly simple results. Multiphase motors, at least so far as the inducing part is concerned, are then special cases of single-phase motors. This results in a very simple method of comparing the two kinds of motors, and which he thinks is here explained for the first time. The theory itself does not admit of being given in abstract.

Theory of Multiphase Motors.—An additional communication of Mr. Danielson, in reference to the discussion with Mr. Heyland, is contained in the "Elek. Zeit.," Nov. 28. He applies the Steinmetz method to the calculation of his motor, and shows that the results are better than if the changes suggested by Heyland had been made.

LIGHTS AND LIGHTING.

The Arc Light.—Prof. Thompson's second lecture (see Digest, last week) is concluded in the Lond. "Elec. Rev.," Nov. 29. He discusses the alternating-current arc; in regard to its efficiency as compared with that of the continuous-current arc, he states that "this is a matter I have not measured myself, therefore I am absolutely unprejudiced, but it seems to me perfectly absurd to suppose that, if you take the right mechanism, select the right size and quality of carbon and use it properly by the light of experience, applying the appropriate amount of current, there will be any difference whatever in the efficiency of the alternating-current arc and that of the continuous-current arc. I do not see where there is room for any difference. . . . If you spend the right amount of energy on the right amount of carbon, by raising it to the right amount of temperature, you are bound, other things being equal, to have equal results." He described the spectrum of the continuous-current arc, as obtained from the crater, the arc itself and the negative carbon. Regarding the "enclosed" arc, he refers to the well-known investigations of Mr. Marks. He quotes some experiments made by Mr. Preece with an ordinary exposed lamp of 6.5 amperes at 50 volts, using 13 mm positive and 11 mm negative carbons, in which he found a mean consumption per hour per ampere for the positive carbon of 3.53 mm and for the negative carbon 2.86 mm. Dr. Strecker of Germany gives 0.75 and 0.375 grammes respectively. He gives the results found by Prof. Walmsley with the Marks lamp during a 14-hour test; when burning open the consumption of the positive carbon was 47 mm per hour and when enclosed, 2.84 mm; for the negative carbon the figures were 18.7 and 0.62 mm; the positive carbon therefore burns away only about $\frac{1}{7}$ as rapidly, and the negative about $\frac{1}{30}$, the total consumption being therefore about $\frac{1}{26}$; there is a drawback in the fact that the glass gradually becomes coated with a brown dust, such that after 18 hours the light was approximately about half as great. He describes at some length the Trotter phenomenon which he characterizes as by far the most important of recently discovered arc phenomena; he refers to the nebulous patch which is more luminous than the rest of the crater, and which moves over it in a capricious way, going sometimes in one direction and then in the other; it can be observed only by resorting to artificial means, such as the stroboscopic method; it appears that there is a rotation of something, the precise nature of which is not known; it is a white object shaped like a sickle, extending over the middle of the crater to the edge and whirls around with great rapidity; sometimes it is double and even quadruple; the concave edge is always the advancing one, which is said to be one of the most puzzling things about the phenomenon; it seems that there is a particular speed corresponding to each current; it seems also that the flame itself is in a state of rapid rotation; it is believed that this phenomenon "puts an end to the hope that the crater of an arc lamp might be used as a standard of light." In conclusion he refers to the recent observations of Mr. Crompton, in which he found that in a steadily burning arc, the arc will suddenly, and for no apparent reason, enlarge itself, flaming out sideways, licking around the upper carbon once or twice, after which everything will resume its former condition; records of volt and amperemeter readings are referred to in studying the feeding of the mechanism; on some of the carbons there accumulated a bronze dust on the conical surface near the crater, and when there is sufficient quantity the arc suddenly spreads upward, sweeps off the dust, and subsides; it was also noticed that when carbons are left in damp places they give rise to great irregularity, even though they are of good quality; the warmth ascending up from the arc does not appear to be sufficient to drive out the moisture, and it is therefore concluded that for a steady light the carbon should be stored in a dry place.

Street Lighting by Arc Lamps.—Prof. Blondel, in the Lond. "Elec.," Nov. 29, replies to the recent criticisms of Mr. Trotter (see Digest, last week). He claims that the curves cannot be inexact or inaccurate as they illustrate geometrical considerations.

Train Lighting.—A system devised by Messrs. Gill and Stone is briefly described in the English journals, Nov. 29, and illustrated in the Lond. "Elec. Eng." It appears that a dynamo is suspended under each car and is driven from the axle by means of a pulley. In connection with this there are eight cells of accumulators which supply current when the train is at rest or when the speed is too slow. It appears that this outfit must be placed on every car, and it is suggested that the repairs and maintenance will be quite great. It is stated that above 20 miles an hour the speed of the dynamo remains constant, "the extra momentum (sic) being taken up in the slip of the belt"!

POWER AND HEAT.

Welding.—The Zerener arc welding apparatus, which has been referred to frequently in these columns, and was illustrated in the Digest, Aug. 3, is illustrated in Lond. "Engineering," Nov. 29, in both the form to be operated by hand, the larger one which is suspended from above; some samples of the work done are also shown. It appears that in a small plant operated by one man and driven by a 5-hp engine, 2000 brazes were made in a week of 54 hours, the brazings being like those on bicycle frames and metallic cornices; tubes of brass, copper, steel and iron have been brazed together, like to like, or copper to steel, brass to iron, etc. In a larger plant of 150 to 300 amperes, steel pipes from $\frac{1}{8}$ to $\frac{1}{2}$ inch thick have been welded longitudinally, the rate of work comparing favorably with the present system of riveting; deck plates up to $\frac{5}{8}$ inch thick have been welded, and a plant for this purpose is being erected. "Seam welding is probably the finest production of the deflected arc system, a sample weld being referred to, 1-16 inch thick, 34 inches long, and 8 inches wide, welded from top to bottom. Steel barrels have been welded throughout, the horse-power required being about 18, with which a steel barrel of 40 gallons capacity was commenced and finished in a little over an hour. Two plants for 300 barrels per week have recently been erected. Another application is to the production of hardened and tempered sections for reaping machines. No accumulators are required, and where a lighting plant is installed, the cost of the accessories is not large.

Electric Plow.—A report of Mr. Legoux on new applications of electricity to agriculture is abstracted in "L'Eclairage Elec.," Nov. 23; it refers more particularly to the recent installation at Enguibaud; he considers the experiments as a success; the power is obtained from a water-falls of about 20 to 30 hp; the plow seems to be drawn by means of cables; no illustrations are given and the description is somewhat complicated; the cost of the whole installation was about $5000, to which must be added the cost of the dams for the water-power, which would be different in different installations.

Worm Gearing.—The article by Mr. Kolben, which was abstracted in the Digest, Sept. 14, is given more fully in the Lond. "Elec. Eng.," Nov. 22 (see also Digest, Oct. 12).

Power Transmission.—The "Jour. of El'ty" for November criticises very unfavorably the recent article by Mr. Adams, which was abstracted in the Digest, Nov. 9. It calls attention to a number of inaccuracies and errors, and after making the corrections it is found that the total cost of installation which he gives is to be divided by at least two, and in place of almost $23 per hour for transmission cost, not more than $10 or $12 should be allowed. Transmissions approximating the distances which Mr. Adams attempts to prove impossible have, "unfortunately for Mr. Adams's figures, already proved themselves to be economical, and such inaccurate statements will do little to advance rational transmissions or to guard against those which are irrational."

Transmission from Coal Mines.—The "Jour. of El'ty" for November states that an effort is to be made to transmit electrical energy from the Corral Hollow coal mines to Stockton, San Jose and other cities, and the power is to be used to operate an electric railroad 32 miles in length from Livermore to Oakland, Cal.

Nevada County Power Transmission Plant.—An illustrated description of the process of constructing this plant is published in the "Jour. of El'ty," for November; the principal feature of the description is the means resorted to for handling the heavy machinery in a very mountainous region. The water head is 206 feet; two Pelton water-wheels are used, each directly connected to a 500-hp Stanley two-phase generator delivering the current at 5500 volts; the line is eight miles in length, and consists of eight No. 3 B. & S. bare copper wires.

Large Electric Crane.—An illustration, accompanied by a brief description, of the large electric traveling crane now in use in a ship-building establishment at Newport News is given in the "Elec. Rev.," Dec. 11. The crane is a large cantilever which travels over an elevated track perpendicular to it, and high enough to carry objects to either of two ships in the course of construction lying on either side of the track. A single motor of a maximum of 80 horse-power is used and transmits its power for the various operations by means of friction clutches; the voltage used is 220, and a traveling speed of 750 feet per minute is said to be obtained; it is operated by one man.

TRACTION.

Power Consumption on Electric Railways.—"Cassier's Mag.," for December, contains a short article by Mr. Baylor in which he considers only the electrical apparatus. The experience of the past two or three years has shown direct connection to have in most cases everything in its favor, and that when land is expensive and the units large, these two points alone will dictate the choice of the type of machine; when a properly proportioned fly-wheel is introduced between the engine and the armature the effects of the great fluctuation of the load in a direct-driven plant become negligible; owing to the slow speed the cost is greater. Regarding the division of the plant into units, he believes that in general it is best to use three units of equal size, two of which are capable of carrying the full load; this allows of efficient running at half and full load, and leaves one unit in reserve; another method is to divide the power into two large units, each equal to half the full load, and a small one equal to one quarter load, which permits running the engine at full load all the time, as combinations of these give ¼, ½, ¾ and full load; but if a large unit gives out the others will have to be considerably overloaded. A generator with a flat efficiency curve should be chosen. He recommended buyers to confine their specifications, within a reasonable degree, to a list of the conditions to be fulfilled, leaving the numerous details of designing to the makers, who are probably better qualified than the designing engineers to determine many of these points. He recommends the use of recording wattmeters, which register the load continuously; also wattmeter readings on separate cars, and a recording voltmeter at the station.

Power Records.—The "St. Ry. Jour." for December reprints a very complete table of power records of the Montreal Street Railway Company for a whole year, a large number of items being given for each month. Among the averages for the year the following are of special interest: 7.5 pounds of coal were consumed per motor-car per mile, or, including trailers, 6.8; the coal burned is Cape Breton bituminous coal; the number of passengers carried per car-mile was 4.1; the coal consumed per ton-mile 1.06, or per passenger per mile 1.66; kw-hours per motor-mile 2.011; watt-hours per pound of coal, 266; watt-hours per ton-mile, 282; pounds of coal per electrical hp, 2.80; kw per ton-mile, 2290; average pull per ton, 19.2 pounds.

Electric Railways of Massachusetts.—A summary of the eighth annual report, dated Sept. 30, of the West End Street Railway Company, of Boston, is published in the "West. Elec.," Dec. 14. It is limited almost entirely to the portion referring to finances. The total mileage completely equipped is 248. There are 261.5 miles of overhead electric feeder lines, 23.31 of underground feeder and 13.93 of underground return lines. The earnings of a number of other Massachusetts roads are also given.

Boston Subway.—An illustrated description of the construction is published in the "El. Ry. Gaz.," Dec. 1.

Conduit Construction.—The proposed construction of the Metropolitan Street Railway Company, of New York, is illustrated and described briefly in the "St. Ry. Jour." for December.

Railway Repair Shop.—A well-illustrated description of the repair shop of the Philadelphia Traction Company, by Mr. Merriam, is published in the "St. Ry. Jour." for December.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Deptford Alternating-Current Station.—The English journals, Nov. 29, publish numerous illustrations of the new machinery which has just been installed at Deptford station (otherwise known as the Ferranti station, from which currents are transmitted to London at 10,000 volts, from very large alternators). The "Elec. Rev." states among other things that there is now every reason to believe that the company is in an exceedingly sound position. The most interesting feature is the recently completed 1000-kw machine, which is considered an admirable piece of work and is said to be the largest machine in Europe at the present time; a brief description of this was published in THE ELECTRICAL WORLD last week.

Ragatz.—Dr. Preller's serial in Lond. "Engineering," Nov. 29, contains a well-illustrated description of the single-phase installation at this watering resort; 200 horse-power developed by high-pressure turbines are transmitted at 3000 volts over a distance of about seven miles; the total cost of the installation, which is given in detail, amounts to about $206 per horse-power; the net receipts for the first year are equal to a return of five per cent. on the capital invested.

Use of Accumulators in Place of Resistances.—Mr. Nodon, in "L'Elec.," Nov. 30, suggests the use of accumulators in electric lighting installations to replace the usual resistances which are required for regulation and adjustment, the object being to save the energy which is otherwise lost in the resistance, and which, in some cases, is by no means small; he refers more particularly to the running of arc lamps (presumably in parallel), for which a resistance in circuit is always necessary; he describes an installation in which this was done, and in which it was found that when accumulators were used the regulation of the arc lamps was remarkably good, the light being much more constant than when resistances were used; the energy saved was sufficient to light a small building with incandescent lamps.

Electrical Engineering in Europe.—"Elec. Power" for December contains a well written article by Mr. Rittenhouse, describing briefly a number of more prominent installations on the Continent, almost exclusively in Germany, and criticising them from the standpoint of an American engineer. Among other things he states that where a multi-phase system is used the three-phase system is preferred to the practical exclusion of the two-phase system; he mentions a storage-battery traction plant between The Hague and Scheveningen, which has been running for six years, "under conditions which would long ago have swamped any similar concern in America;" the distance is about four miles; the road has 13 cars, each with only one motor; the voltage is 70, and the cars make four round trips with one discharge. On a trolley road in Brussels the guard wires are replaced by a rope treated with water-proof material and of a slightly larger diameter than the conductor, fastened to the upper side by means of small clamps; he considers it an improvement on the American system; the first cost probably compares favorably with that of the other, and it is both neater in appearance and involves less cost of maintainance. Regarding the use of storage batteries in central stations, he states that a comparison shows the total first cost of a combined battery and steam plant to be considerably greater than that of a steam plant alone, the capacity of which is double that used in conjunction with a storage battery of equal capacity; it is generally recognized that a battery is a desirable adjunct; it appears that the guaranteeing of the battery covers a period of only two years, which he says is quite safe for the manufacturers, as the greatest deterioration follows that period; the depreciation, he says, is far in excess of that of the machinery; he wonders what the basis is of so much enthusiasm regarding batteries. Nearly all electrical manufacturing companies are using electrical motors more or less extensively for driving their machine tools; in one case which he mentions a change was made back to the usual method after having tried electrical motors. He gives a brief description of the Frankfort single-phase alternating plant, which he considers is the finest specimen of its kind on the Continent; the motors attached to the circuit are operated by means of condensers and resistances while starting, and the load is thrown on by means of a friction clutch; 110 volts and large transformers sufficient to supply a number of customers are used in place of "our abominable American practice" of using 50 volts and small transformers for each consumer; the concentric cables are surrounded with sand, and are laid only a short distance below the surface of the sidewalk; the feeder cut-outs consist simply of fuses buried in sand, which gives them a definite fusing point. A description of the three-phase plant at Leipsic is given, together with a diagram of the system; he believes it to be the largest three-phase plant in Europe; the three-phase current is generated about one mile from the distributing station, where it is transformed by three-phase motors into a continuous current of 250 volts, which is distributed over a three-wire system in connection with storage batteries, which are used during the heavy load hours; in addition to these transformers

there are some motor transformers which will generate 1400 amperes at 30 volts, and which are used as boosters for charging the batteries; the capacity of each set of batteries is 858 amperes for 3 hours; it appears that the cost of the battery plant is about $\frac{1}{13}$ that of the total cost of the plant. The water-power plant of the Isar Company, near Munich, is described; several descriptions of this plant have been referred to and abstracted in the Digest.

WIRES, WIRING AND CONDUITS.

Concentric Wiring.—An Institution paper on this subject by Mr. Mavor is reprinted in full in the Lond. "Elec.," Nov. 29. In the first half he discusses at some length the poor workmanship which is so common in wiring; he claims that much work is done by irresponsible amateurs who are ignorant of the consequences of careless work; insulation tests after the completion of the work, if in dry and well-seasoned buildings, are of little value, as the insulation resistance might be very high, although there are many dangerous defects only awaiting an opportunity to develop; he points out the uselessness of rules if they are not enforced; he very emphatically condemns wood casings and the indiscriminate use of fuses, which are not only a nuisance, but are apt to be a positive source of danger; the smaller the number of fuses the better, but they must be absolutely reliable; most of the leading contractors have adopted the distribution-box plan of wiring, in which the fuses are grouped at the distributing centres, a system which he thinks should be made compulsory; the use of isolated fuses should be strictly prohibited. Regarding the switches, he states that they have been greatly improved, but that there are still too many parts and contacts; he recommends soldering the wires to the contact plates, and soldering the wires in the lamp holders also. He then points out at considerable length what he considers to be the great advantages of the concentric method of wiring with an uninsulated outer conductor, a method which he praises very highly, and with which he appears to have had considerable experience. He seems to consider a concentric wiring system, in which both conductors are insulated, as impracticable for indoor work, chiefly on account of difficulties in designing junction switches and other accessories; he claims that the concentric system is entirely different from the "single-wiring system," with which it has often been confused; in the concentric system the conductor is everywhere surrounded over its insulation by a metallic sheathing of a conductivity equal to or greater than that of the core (it seems furthermore that the outside sheathing is a continuous tubing, thus protecting the insulation from moisture); the switches and fuses should be in the central wire and enclosed in metallic cases, which are jointed to the outer conductor; "the adoption of concentric wiring is the royal road out of difficulties and dangers which beset double wiring;" it dispenses with the necessity of insulating both wires and abolishes the risks which make a high standard of insulation of both conductors in a two-wire system so desirable; it seems that the English insurance companies are now unanimous in their favorable verdict on the subject, and have recognized the advantages of concentric wiring from their point of view. It is not true that the liability to break down of the insulation is doubled because one conductor is earthed; the thickness of the insulation between the conductors is so small that a fault immediately develops in it a short circuit and the spark, being entirely within the sheathing, cannot communicate fire to its surroundings; he furthermore claims that "we never have faults in lead-covered concentric conductors." One of the chief advantages is that it is so effectually made water-proof, as the cables may be enclosed in lead sheathing laid under or over the outer conductor; the next important advantage is the large reduction of the number of fuses; the best method to abolish fuses is to maintain the section of the conductors, which can readily be done in this system to an extent which is impracticable in the others; when the number of fuses is reduced they are easily centralized in groups of standard sizes; the objection that a large number of lamps are affected by one fuse does not hold in this system, as "we never have short circuits"; in regard to fittings, a comparison is again claimed to be in favor of concentric wiring. The main cables, which are lead sheathed throughout, are generally armored with galvanized iron wires separated from the lead by a layer of jute, and these are led without a joint to the distributing boxes, from which the branch cables are generally all of uniform section equal in area to 0.005 sq. in. (about a No. 12 B. & S.); the outer conductor has the same section of copper as the core and the whole is enclosed in a solid drawn tube of lead; joints appear to be made by means of special jointing pockets. The central wire and its insulation are therefore enclosed throughout in a hermetically sealed metallic sheathing; no reduction in the size of the branch conductor as given above is made; there is no necessity for any fuses other than those in the cast-iron fuse box, and all these are interchangeable. Large installations have been carried out on these lines, some amounting to several thousand lamps, in which only two sizes of fuses, main and branch, were used; he emphasizes the simplicity and reliability of such a system. His company has for years imbedded the conductors in the plaster, and they have never known a single case of a fault developing in such conductors; he claims that there is no need for their being accessible; a nail driven through the wire immediately makes a short circuit, which is easily located. He cites a case of a building in which explosives are manufactured, the wires for which are all on the outside, where they are exposed to the weather; it has been in use for three years, and the insulation is as high as ever; the insulating material is fibrous, and not india rubber, the exclusion of the moisture is therefore solely due to the outside sheathing; the more difficult the wiring of the building, the more favorable is the comparison with concentric wiring; it is especially adapted for mining work, where crushing a wire melts the fuse before the cable is parted, thus avoiding the spark in the atmosphere of the mine; it is also specially adapted for ships on account of its water-proof qualities, and because, if well arranged, there is no effect of the wire on the compass of the ship, which has been proved by careful testing. Regarding the possible electrolysis of the outer conductor, he states that on long lines the risk may be entirely avoided by adopting very simple precautions, one of which is that the fall of volts should be nearly all in the inner conductor, the copper saved from the inner being added to the outer; another method is to apply a slight insulation between the outer conductor and its lead sheathing, and to earth the outer conductor at the distant end. No disturbances to telephones can take place in such a system. "The present supposed insulation of the three wires is a sham, and the sooner we acknowledge it the better. Experience has proved that good insulation of all three conductors in an extensive network cannot be reliably maintained. Then why not face the difficulties, and end them by earthing the middle wire?"

The Neutral Wire of a Three-Wire System.—The "Elek. Zeit.," Nov. 28, contains an article by Mr. Lohr, devoted to the discussion of the neutral wire. When the neutral wire carries a current the potential difference in it acts as a loss of voltage for the machine carrying the larger load and has an increase of voltage for the other; if, therefore, the loss of voltage in the outside wire carrying the smaller load is less than in the neutral, there will be a greater voltage at the corresponding lamps than at the dynamo; these conditions may occur when the cross-section of the neutral is less than that of the outside wires, when the conditions are not all normal, but even when running regularly the effect of the neutral on the distribution of the voltage is sometimes unpleasantly great; to avoid this it is necessary to calculate the size of the neutral; between the two sides there may be a difference of load of 2 to 10 per cent. of the total, which difference may be used as a basis for the calculation of the neutral; an illustration is given. He shows that it is important to use the true conductivity of the copper, which corresponds to the particular current density, as the difference due to the heating may become important. For an installation of about 1000 amperes maximum, a difference of load of 10 per cent. and a difference at the dynamos of 5 volts, the cross-section of the neutral would be 60 per cent. greater than that of the outside wires; with underground insulated neutrals, the three wires should be made to have the same cross section; with a bare neutral, the cross-section had better be calculated; while if underground, it is essential; for the neutral cables of the distributing system it is sufficient to use half the cross-section of the outside wire, if it is insulated. He urges the use of at least two neutral cables from the central station. The best position of the neutral is between the two outside wires, thus avoiding a short circuit between the latter. It is necessary when the neutral is insulated to connect it at the station and at several points of the network to earth; fuses must then never be placed in the neutral. If bare wires are used for underground work, a practice which he believes will soon become universal, oxidation and electrolysis must be considered. Experience has shown that the former is not important, as such cables which have been in the earth for three years were found by the writer to have only a thin coating of oxide, which it is presumed protects the cable from further oxidation; he notes a case in which electrolysis was serious; a provisional line running somewhat over 1000 feet from a neutral feeder, there was a difference of about three volts between the two, and the distance through the provisional cable being several thousand feet greater, the larger part of the return current came through the earth, and the result was the electrolysis of the provisional wire, and also of the armor of the feeder; this shows the importance of diminishing as much as possible the earth currents; these currents are smaller the smaller the loss of voltage in the neutral, the smaller the surface exposed to the earth and the greater the extension of the wires in one direction; bare wires should be larger than insulated, partly to lower the loss of voltage and partly to compensate for the reduction of cross-section due to oxidation; each duct in the distributing portion should contain only a single neutral wire; a connection of the neutral wire with the armors of the outside wires had better not be made, even though it may seem desirable, partly because such a connection, to be permanent, is very difficult to make; in spite of the larger cross-section a bare neutral is still much cheaper than an insulated one, the cost being about half as great; there is an additional saving in the junction boxes; among the other important advantages of a properly laid bare neutral are: The greater equality in the voltage at the lamps, more favorable operation of the machines and greater reliability. All branches which are only connected to one side, as, for instance, open portions at the end of the wires, and the connections to houses, should be made with insulated neutrals; use of bare wires for houses should be avoided by all means as they will soon be destroyed by oxidation; joints on bare neutrals should be protected from oxidation, as, for instance, by covering them with an insulating material while still warm

from being soldered, and then covering with jute. Neutral pressure wires he considers absolutely necessary; in the installations in houses it is well to adhere to the usual practice of using the same cross-section for the neutral and outside wires; in such places the neutral should be without fuses when a three-wire system is carried out, but where a two-wire system is used it should be protected with fuses on account of the possibility of a change in the polarity.

Interior Conduit System.—An Institute paper by Mr. Bathhurst is published in part in the Lond. "Elec. Rev.," and "Elec. Eng.," Nov. 29. He discusses the defects of the ordinary systems, and points out the advantages of the well-known interior conduit system, which he describes. In an appendix he gives the insulation resistance required in various countries for voltages not exceeding 250; among these are the following: For an installation in which the current is 10 amperes the insulation resistances required in London, New York, Cologne and Vienna are respectively 500,000, 2,000,000, 100,000 and 50,000; for 50 amperes these figures are as follows: 120,000, 400,000, 20,000 and 10,000; for 500 amperes they are 12,000 (the figure for New York is not given) 2000 and 1000.

Rules and Regulations.—The English journals, Nov. 29, continue to discuss and publish reports concerning the new proposed regulations of the Board of Trade.

ELECTRO-PHYSICS AND MAGNETISM.

Discharges in Gases.—An article by Mr. Lamotte is begun in "L'Eclairage Elec.," Nov. 23. He gives a summary of the researches of Lehmann, references to the originals of which are given. Among some of the results are the following: The glow discharge corresponds to a small positive and a small negative intensity; the needle discharge to a small negative and a great positive intensity; the "train" discharge to a great negative and a small positive intensity; a spark discharge to a great negative and great positive intensity. The glow discharge is produced when the distances between the poles of the micrometer is greater than the explosive distance or when there is no micrometer; the needle discharge, when the micrometer is on the positive side; the train discharge when it is on the negative; a spark discharge when the circuit contains a Leyden jar and when the distances between the poles of the micrometer are sufficient for the jar to take an appreciable charge. In the above cases the pressure of the gas corresponded to several millimeters of mercury. There is always a definite demarcation between the various discharges. The characteristic difference of color of the positive and negative lights, as claimed by a number of experimenters, does not exist. When the discharge is concentrated on a small section, the color is red, while if over a large surface, it is bluish. As the air pressure is diminished, its luminous effects are extended more and more, and they are concentrated when the pressure increases. The train discharge is more difficult to produce as the cathode becomes more blunt, and the needle discharge becomes more difficult when the anode is blunt; it is more difficult to produce the spark when the electrodes are pointed, especially the negative; when one of the two conductors is connected to the earth, the luminous phenomena appear only on the insulated one.

Conductivity.—A paper by Messrs. von Aubel and Paillot from the "Jour. de Physique," for November is abstracted in "L'Eclairage Elec.," Nov. 23, and noticed briefly in the Lond. "Elec.," Nov. 29. They discuss the validity of the law of Wiedemann and Franz, that metals of fairly good thermal conductivity have an electrical conductivity varying in proportion; with aluminium bronze, constantane ferro-nickel, all of high electrical resistance, they found that the law is anything but verified, although a rough correspondence was observed; the law evidently holds only for pure metals of a homogeneous structure.

Magnetic Self-Induction.—A paper by Mr. de Nikolaieve from the "Jour. de Physique," is abstracted in "L'Eclairage Elec.," Nov. 23, and noticed briefly in the Lond. "Elec.," Nov. 29. He discusses the cause of repulsion of the Elihu Thomson ring, stating that "a piece of iron attached to the end of the core of an electromagnet will drop off if a disc of copper is moved along the core. An increase of the magnetizing current is observed at the same time. This diminution of the attraction of the iron is due to magnetic self-induction."

Converting Heat into Electrical Energy.—"El'ty," of Nov. 20 and Dec. 11, reprints a recent paper by Mr. Le Pontois, read before the Engineers' Society of Western Penna., on "The Inefficiency of the Direct Methods of Converting Heat Into Electrical Energy." He endeavors to show that "after all, the most economical solution of the problem lies in the construction of a more perfect heat engine driving the already highly efficient dynamo," and he gives the reasons on which his belief is based. He discusses in some detail the various direct methods; among them the Thomson and Peltier effects; "if the formation of magnetic whirls around the conductor characterizes these long ether waves, known as electric waves, why should not the propagation of these shorter ether waves, called heat waves, along a conductor, be also attended with the formation of magnetic fields of force in the surrounding medium? It seems pretty well established that the only difference existing between electric waves and light waves is solely a question of wave length, Both are electromagnetic disturbances. Why not extend this appellation to heat waves, which are much more likely to present the same characteristics as electric waves, by reason of their wave length being much longer than the wave length of light waves." The only reason why heat, light and electricity do not apparently possess the same electrical capacity must be attributed to the fact that the bodies which are considered as conductors of electrical energy present great resistance to the propagation of the rapid vibration characterizing heat, and a most insuperable resistance to the rapid vibrations of light. By introducing this hypothesis in the study of thermoelectric phenomena it becomes very easy to understand them; an illustration is given. The Peltier effect is described and the theories discussed, that of Becquerel being given preference. He states that the thermo-pile may be considered as an imperfect heat engine working between two temperatures, on which basis he calculates its theoretical efficiency and applies it to the case of a German-silver iron couple and obtains the value 1.358 per cent., but this, he says, is not absolutely correct. He compares the efficiency of the thermo-pile with that of a gas engine. The best thermo-pile requires 25 cb. m of gas per kw-hour, while a good gas engine and dynamo require 1.35, the former being nearly 18 times as great. In the second part the pyromagnetic generator motor is described and discussed; the best efficiency of this machine he says has never exceeded 2 per cent. and he believes it cannot be improved upon very much; the small output with reference to the size, is due to the very slow speed at which the magnetic reluctance of the iron can be modified by heat; 120 heatings per minute are about the fastest rate, while in a dynamo the corresponding changes are 1200 at 1200 revolutions per minute showing that the output of the dynamo is ten times greater; as in all heat engines the efficiency of this motor depends on the conditions in the working temperatures and on the proximity to the points of maximum effect; for the best results this difference cannot be greater than 15 degrees C.; the theoretical efficiency is therefore only 1.9 per cent.; if the greater part of the heat actually consumed could be made equal to the difference in specific heats, then the efficiency might be increased, but this is obviously impossible. He describes briefly the Berliner and Tesla thermomagnetic generators, but the efficiency, he says, is not greater than that of the one which is described above, as both are based on the same principle. He believes that it is not very likely that electricity will ever be obtained efficiently from heat; when the Tesla high-potential, high-frequency system becomes as practical as it is efficient "then we might succeed in obtaining the considerably shorter electric waves used in that system direct from heat."

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Tanning.—Mr. Nussbaum, in the Lond. "Elec. Rev.," Nov. 29, states that Mr. Worms has patented a new accelerated process of tanning different from that which formerly bore his name. It is in practical use in Paris, where it is said to be giving such excellent results that the company has decided to increase the plant. Facilities are offered for making tests. No further information is given.

Chemical Analysis.—A recent article by Dr. Neumann, on "Which Electrolytic Methods Can Be Used with Advantage in Analytical Practice," is translated from the "Zeit f. Electrochem.," Nos. 11, 12 and 13, in the Lond. "Elec.," Nov. 29.

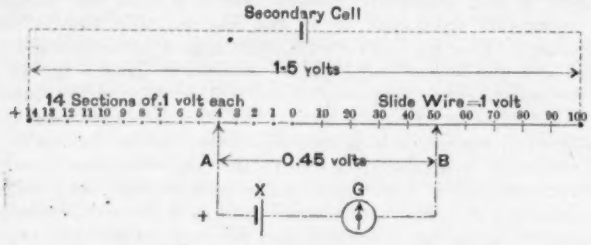
UNITS, MEASUREMENTS AND INSTRUMENTS.

Galvanometer Design.—The "Phil. Mag.," for December contains an article by Prof. Holman (Mass. Inst. of Tech.). Messrs. Ayrton, Mather and Sumpner in 1890 showed by demonstration that in the coil of a sensitive Thomson galvanometer the current in a portion of the central turns affected the needle, in opposition to the remaining major part of the turns, so that this portion should be left out or connected in reverse connection. The present writer points out the partial incorrectness of this statement; it is true that the turns in a small volume, near the centre of a solid coil, would have a reverse effect, but the volume is roughly, only ¼ to ⅛ of that indicated by those writers; it is approximately a sphere whose diameter is about ½ of the length of the needle, and it therefore becomes entirely insignificant in practical construction as the greater part of such a space must be left for the needle; the error in the demonstration arose from the fallacy of considering the deflective movement of the needle as due to the field of the poles only, regardless of the fact that the field of the remainder of the needle is not the same; a demonstration is given; he also shows that there is no gain in reversing these inner windings. He concludes that it is practically useless to wind turns within a distance of about ¼ of the needle length to the coil centre, and that to increase the sensitiveness the needle must be made as short as is consistent with the torsion of the suspension.

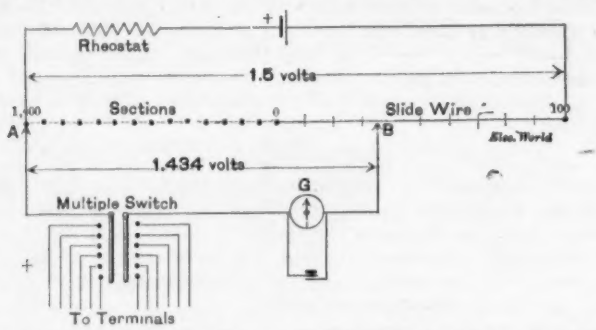
Measurements of the Coefficients of Self-Induction.—A paper by Mr. Kolacek from the "Wied. Ann.," Vol. 55, page 604, is abstracted in "L'Eclairage Elec.," Nov. 23. It is devoted chiefly to a discussion of the theory. The method, which he says is quite simple, and applies chiefly to coefficients of low value, seems to be to place the circuit, closed on itself, in an alternating magnetic field, and to measure the electrodynamic couple to which it is subject, by a torsional method. If there is no uniform field at one's disposal, the electro-dynamometer may be used, the magnetizing current being passed through the fixed coil, while the movable coil is short-circuited at first on itself, then through a coil of known self-induction, and then through the coil to be measured, maintaining the current in the fixed coil constant. If the resistances are known, the results enable one to calculate the unknown coefficient. A condenser may also

be inserted, and the method will then enable one to determine the capacity.

Potentiometer.—A series of articles by Mr. Fisher on the use and capabilities of the Crompton potentiometer, is begun in the Lond. "Elec.," Nov. 29. He states that the potentiometer system has recently been universally adopted by central-station engineers and others, as it affords a method of accurately comparing with some acknowledged standard, any unknown current, voltage or resistance, the range being infinite and the simplicity very great, involving no calculations or corrections for temperature, etc., the errors being within one tenth of a per cent. under ordinary circumstances, while with special care a far greater degree of accuracy can be attained. Briefly described, the instrument consists, as shown in the adjoining diagram, of 15 sections of wire in series, 14 of which are in



the form of coils, the fifteenth being stretched along a suitably divided scale; with 1.5 volts at the ends of the series, the scale below the slide wire, which is divided into 1000 parts, corresponds to 0.0001 volt per division; the unknown quantity x to be measured is placed in series with the galvanometer G in the adjoining figure and connected to the movable contacts A and B; there is no deflection of the galvanometer when balance is reached; under certain circumstances, especially when measuring a resistance, it is advisable to alter the main voltage. The instrument is



calibrated, as shown in the diagram, by means of a Clark cell, the E. M. F. of which is taken as 1.434 volts, which is the certified Board of Trade value at 15 degrees C.; the contacts A and B are placed at 14 and 34 respectively, and the resistance in the main circuit is adjusted until there is no deflection; with the resistance standards made up to the present time, measurements may be made up to 10,000 amperes and 3000 volts. To measure a current, it is passed through one of the standard low resistances whose value is such that the voltage at the terminals comes within that measureable on this instrument, namely 1.5; the usual resistances adopted by the majority of the stations, are for a maximum current of 1500, 750, 150, 15 and 1.5 amperes; they are proportioned so as to be direct reading, that is so that the voltage measured corresponds to the current, with some convenient multiplier; the water, cooled resistances used were described in The Electrical World, Nov. 30, p. 588; no danger need be anticipated in connecting these resistances to the ordinary water supply, as a moderate length of ordinary hose pipe amounts to practical insulation; 30 feet of the ordinary rubber tubing of ¼ inch bore filled with London water and laid for its whole length along a lead floor, when tested from end to end with 100 volts had a resistance of one megohm. For measuring voltages higher than 1.5, the two terminals of the source are connected through a high resistance and the fall over some portions of this is measured. For comparing resistances a current is passed through the unknown resistance and one of the standard resistances of about the same value, and a current which is suitably adjusted is passed through both, the voltage at the terminals of the standard and the unknown are then measured with the potentiometer; the balancing may be done by four different methods; conductivity tests are made in a similar manner; if the comparison is made with a known copper standard it becomes very much simpler. The application to measuring temperature in connection with the platinum thermometer is also described, the resistance of which is measured by comparison with a standard in the same way as above described; he gives the constant of the platinum as 0.38 per cent. per degree centigrade.

Testing Switch.—The Norman switch is described and illustrated in the Lond. "Elec. Rev.," Nov. 29. It is a somewhat complicated switch, with one handle which may be put in a number of different positions, in each of which it makes the proper connections for a specific test of a cable. The switch itself contains a number of resistances, and need only be connected with the cable, galvanometer and battery. It is so arranged that no special knowledge of the work of electrical testing is required; the ordinary dynamo attendant may therefore make all the required tests with rapidity and accuracy; all the operations requiring a discharge, a key, a set of shunts, a short-circuiting key, a battery and a cable key, etc., are performed by this switch. An illustration is given together with diagrams showing the connections.

Dependence of Standards of Light on the Surrounding Atmosphere.—A translation of the article by Dr. Leibenthal, which was abstracted in the Digest, Nov. 2, is reprinted with the table, in the "Prog. Age," beginning with the issue of Dec. 2.

Photometry.—The "Prog. Age," Dec. 2, begins a series of articles on photometry, reprinted from various sources, with reference chiefly to gas-lighting interests. It includes also a discussion of Mr. Humphrey's paper, which was noticed in the Digest, Nov. 16.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electrical Equipment of Modern Office Buildings.—In an article by Mr. Sachs, in "Elec. Power" for December, he mentions a number of different purposes for which electricity is used in modern office buildings, besides the usual applications for lighting and power; he makes suggestions regarding the systems of wiring, and refers more particularly to the signalling and inter-communicating appliances, showing that quite an extensive amount of wiring is necessary; he recommends that these wires should be run in tubular or other insulating wire-ways arranged like those for lighting, with outlets at properly arranged junction boxes. Regarding the telephones, he thinks it might prove feasible and economical to have a central switchboard in the building, at which connections could be made with several trunk wires, or with various subscribers in the same building; he recommends the introduction of an electric time service, of special telegraph wires, wires for stock quotation instruments and, perhaps, burglar alarms for depositing vaults, as also fire alarm signals and messenger services; he describes at some length a system of signalling for elevators; watchman's time detector and automatic controllers for heat regulators are also recommended.

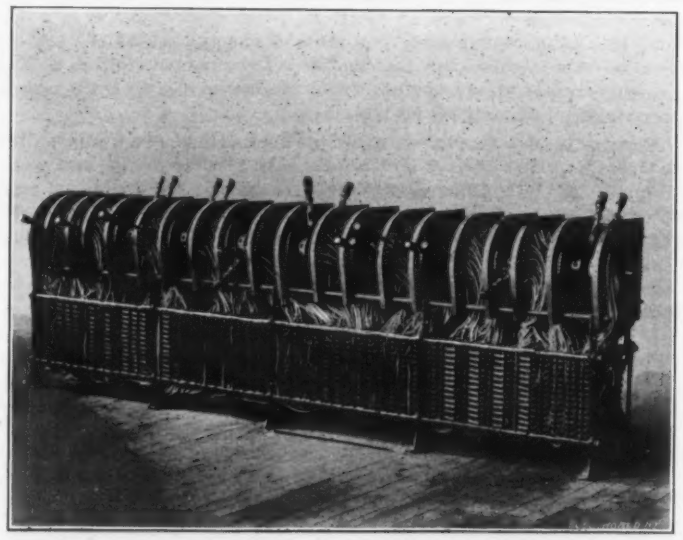
Postal Telegraph Company's Building in Chicago.—The "West. Elec.," Dec. 14, publishes a long, well-illustrated description of this building.

MISCELLANEOUS.

Checking Hemorrhages.—According to "Elec. Rev.," Dec. 11, Dr. Jenison, of Minneapolis, reports that "electricity (*sic*) has been successfully employed by him in checking a hemorrhage from the extraction of teeth"; the current caused a coagulation of the blood and gave relief where the usual remedies were without effect; no further information is given, nor is it stated how the current is applied.

A Theatre Dimmer.

The accompanying illustration furnishes an example of the perfection to which theatre dimmers have recently been brought. This dimmer, which was recently installed in the Star Theatre in New York City by the Carpenter Rheostat Company, controls 1400 lights arranged in 18 separate



Theatre Dimmer.

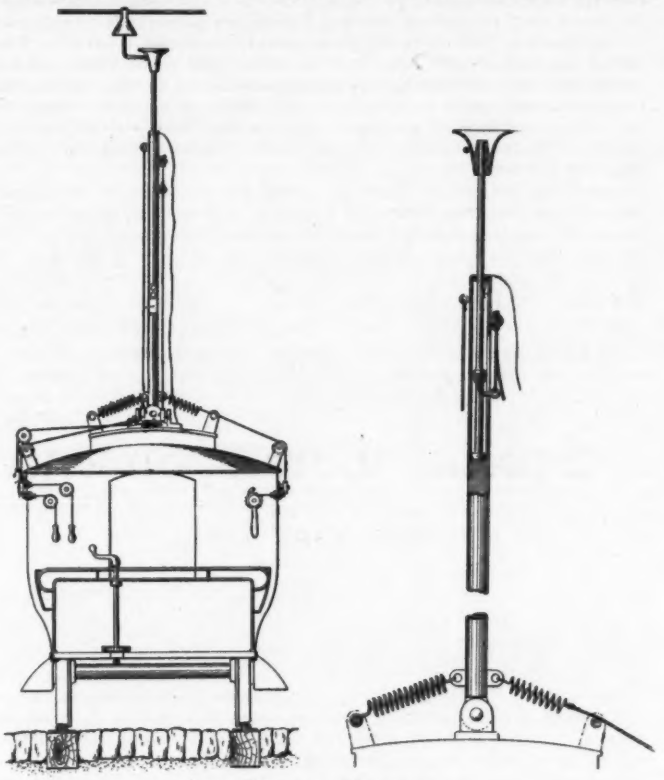
circuits; each circuit can be dimmed separately or any number of circuits can be collectively dimmed by the movement of one lever. When the great space occupied by the former type of dimmers is remembered, and the great fire risk incidental to carrying the hundreds of circuits through the floor from the switches above to the boxes of coils below, it is evident that the improvement in this department of electric work has been exceptional.

Side-Contact Trolley.

We illustrate herewith, from the patent specifications, a side-contact trolley, for which a patent was granted Nov. 26 to George Westinghouse, Jr., on an application filed June 13, 1890.

The trolley consists of a base-plate or step on top of the car, to which is hinged, in suitable lugs so as to swing laterally to the length of the car, a rigid arm or pole, which is further supported by pivoted braces to prevent motion longitudinally to the car. The upper end of the arm is made hollow or tubular for the purpose of receiving a round rod or tube, which fits loosely enough within the bore to be capable of both axial and radial movement, and is provided at its outer end with an electrical contact piece or collector.

The collector may be made of a tapering or inverted-bell form, having a wide flange to extend over the top of the line conductor with which it



SIDE-CONTACT TROLLEY.

is used, in order to more certainly preserve contact. It is held against the side of the line conductor by one or the other of two springs, secured at opposite sides of the arm near the lower end. One of these springs is normally stronger than the other, so that it has a tendency to throw the arm over in its direction, and thereby cause it to bear against the opposite side of the conductor. When, however, it is desired to cause the arm to be drawn in the opposite direction, to bear against the other side of the conductor, greater tension is put on the other spring by means of a cord or chain leading to a windlass or other place accessible to the motorman. To provide for variations in the altitude of the conductor, the rod of the arm may be raised or lowered by a cord leading to the platform of the car.

Some New Specialties.

We illustrate herewith two specialties which are being placed on the market by the Fiberite Company, of Mechanicville, N. Y. Fig. 1 shows a pony switch of unusually strong construction and good finish. The blades are of rolled copper, and the fittings of polished bronze. The switch is mounted on a polished slate base. This handy little device is made in three sizes—15, 25 and 35 amperes.

Fig. 2 illustrates a sleet-cutting trolley-wheel, the construction of which

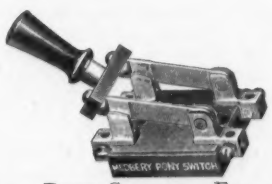


FIG. 1.—PONY SWITCH.

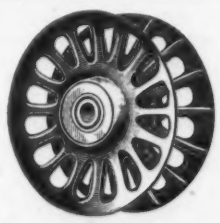


FIG. 2.—SLEET-CUTTING TROLLEY-WHEEL.

is plainly shown by the cut. The inner cheeks of the flanges are provided with cutting ridges extending radially from the bottom of the tread to the outer edge of the flanges. Holes are cored out between the ridges in order to allow the escape of the ice-cuttings, as well as to lighten the wheel.

Electricity in Powder Mills.

In November, 1894, the Ætna (Ind.) Powder Company decided to install two small slow-speed generators for operating incandescent lamps on the Edison three-wire system. As these, when ordered of the General Electric Company, could not be delivered immediately, two second-hand machines were installed temporarily, and before the first two new ones ordered could be delivered the order was changed to two larger moderate-speed generators, with the privilege of changing them for two others still larger. In June, 1895, the last two were ordered, together with two motors, one of 1 hp, the other of 5 hp. On Aug. 2 the Ætna Company ordered another motor of 5 hp, and on Aug. 14 still another of the same capacity. The company having enlarged its plant during the Summer, found its electrical installation insufficient, and on Oct. 12 ordered two 45-kw moderate-speed generators and two moderate-speed motors, one of 20 hp, the other of 30 hp. Thus within one year electricity had given the Ætna Powder Company such satisfaction that it now has 66 hp in motors and 93 incandescent lamps, taking current from the two 45-kw generators. The one-hp and the five-hp motors are used to drive small mixing machines in the manufacture of dynamite. The 30-hp motor operates a large machine used for pulverizing nitrate of soda, and that of 20 hp runs a number of machines, such as the dry pan and mixing machines. It was found that the first five-hp motor, which was substituted for a steam engine, readily performed a duty with which the engine found difficulty.

During the past year the General Electric Company has equipped several powder mills with electric motors, and it is thought by some that present indications point to the speedy complete elimination of the steam engine from the operation of machinery in and about powder-manufacturing establishments.

Three- and Four-Point Switches.

The accompanying illustrations represent two switches which are being manufactured by the Anchor Electric Company, of Boston. Fig. 1 shows a three-way switch and Fig. 2 a four-way switch, of compact and substantial design; the mechanism embodies the well-known quick-releasing principle which has been applied to the simple switches made by the same company. The contact pieces are ample as to area of rubbing surfaces, as well as cross-sectional area, and the material is of high conductivity combined with excellent wearing qualities and great resilience.

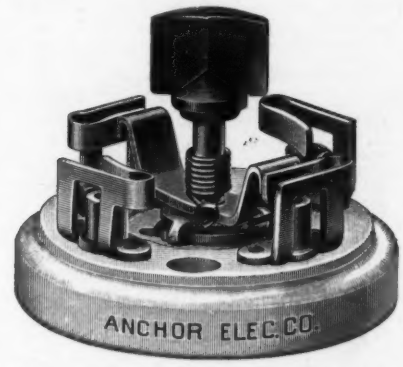


FIG. 1.—THREE-POINT SNAP SWITCH.

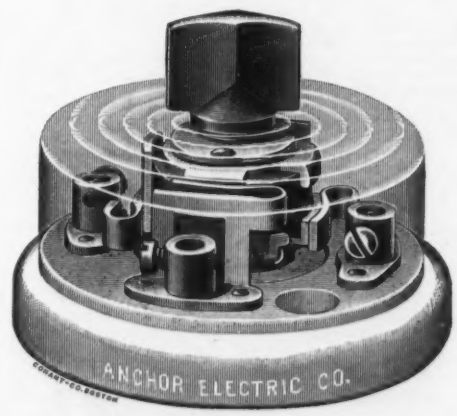


FIG. 2.—FOUR-POINT SNAP SWITCH.

The function of a three-way switch is well known; the employment of a four-point switch for controlling a light or group of lights from three different points, independently, is, however, not quite so common, but will doubtless come into more extended use.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Dec. 14, 1895.

AMERICAN BELL displayed more strength during the latter half of this week than it has for quite a while, the closing prices of Thursday and to-day being 203 and 202½ respectively. The abrupt step from 200 on Wednesday to 203 on Thursday was probably due in large measure to the announcement on Wednesday afternoon of an extra dividend of 1½ per cent. payable along with the regular quarterly dividend of 3 per cent., also announced Wednesday. This makes a total of 15 per cent. dividends declared this year, which, though not so good a showing as was made in 1893 and previous years, is equal to last year's dividends, and better than was expected by conservative champions of the stock.

EDISON ILLUMINATING, OF NEW YORK, reports net earnings for November of $90,755 against $92,495 for November of 1894.

EDISON ILLUMINATING, OF BROOKLYN, reports $36,960 net earnings for last month as compared with $30,129 for November of last year—an increase of $6,831.

WESTERN UNION'S SURPLUS for the quarter, ending Dec. 31 (partly estimated, of course), is placed at $264,505, which is $99,305 better than the showing for same period last year.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	95¾	97½
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	39	39½
Electric Storage, pref	100	40	41
General Electric	100	31	31¼
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	33	33½
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202	202½
American District Telegraph	100	35	40
American Telegraph & Cable	100	95	95½
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	61½	62
Gold & Stock Telegraph	100	105	..
New England Telephone	100	89	90
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	88⅝	89

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17⅝	17⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11	13
" " pref	100	59	61
Buffalo St. Ry	100	72½	73
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	47	50
Electric Traction, Philadelphia	50	..	..
Hestonville	100	54	..
Long Island Traction, all pd	100	19	20
Louisville St. Ry. com	100	37	39
" " " pref	100	87	88
New Orleans Traction	100	19	20
" " pref	100	67	68
North Shore Traction	100	32	34
" " pref	100	83	85¼
People's Traction, $30 pd	25	..	..
Philadelphia Traction	50	70½	71½
Rochester St. Ry	..	..	37
Steinway, Ry	..	46	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	13⅝	13⅞
West End, Boston	100	70	70½
" " pref	100	93	..
Worcester Traction	100	15	17
" " pref	100	84½	86½

BONDS.

Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	98	101
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

THE TRACTION MARKET has been extremely quiet and prices have changed but fractionally since last week. Brooklyn City Railway stock has been the strongest feature on the list, and on the announcement yesterday of the sale of the Long Island Traction Company's property for $5,500,000 to the Reorganization Committee the price quickly advanced to 173 bid. The stock closed considerably stronger than for some time past. The contest by the various Brooklyn trolley roads for the possession of new streets continues to be a feature of the local situation. The Brooklyn Heights (controlling the Brooklyn City Railway) has offered to pay to the city 3 per cent. of the gross receipts if the franchises be sold at public auction, or has agreed to bid up to any reasonable amount.

BUFFALO RAILWAY stock shows further declines and continues to be offered down, with but few sales reported. The consols, however, have advanced slightly and some few bonds have changed hands at 104½ and interest.

NEW ORLEANS TRACTION.—The annual meeting of the New Orleans Traction Company stockholders has been called for Jan. 6 in New Orleans. The common stock has advanced to around 19½, while the preferred continues inactive around 67. The November gross earnings have increased $29,695.

COLUMBUS STREET RAILWAY stock is somewhat firmer. In spite of the fact that about $39,000 has been expended on the road during the past eleven months, the net earnings for that period show an increase of about $18,000.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 16, 1895.

BIDS FOR CITY LIGHTING.—All the bids for arc lighting which were given in this column last week, have been accepted by the commissioners, with the exception of that submitted by the North River Company.

THOMAS G. OAKES, formerly with Jenkins Brothers, after an experience of 16 years in handling valves and packing, has decided to engage in business on his own account at 52 John Street, with valves and packings made according to his own ideas. He will also act as salesman for the Mason Regulator Company, of Boston.

THE MICA INSULATOR COMPANY, 218 Water Street, has bought the business of the Empire Electric Insulation Company, of Schenectady, manufacturers of oil paper and cloth for insulating purposes, and will continue this business in conjunction with the manufacture of its widely-known "Micanite" specialties. It is of interest to American engineers to know that the Micanite pole-piece caps for the new Ferranti alternatar, which were subjected to a test of 25,000 volts, were made by the Mica Insulating Company.

JOHN C. DOLPH, 126 Liberty Street, Eastern manager for the Forest City Electric Company, reports that his company's business has assumed such proportions as to necessitate the operation of the factory 24 hours a day. Mr. Dolph modestly refrains from adding that fact that a very large proportion of this business is sent in from the New York office. The company has added a new type of commutator segment to its long list of "roll-drop" goods, which is designed for both styles of W. P. railway motors.

ADAM COOK'S SONS, proprietors of the Albany Lubricating Compound & Cup Company, 313 West Street, whose "Albany" grease has such an enviable reputation among engineers, will soon issue an elaborate catalogue giving the different results obtained by the use of the best oils and mineral greases in use to-day, in comparison with their Albany compound. Many street railways are using Albany grease with excellent results, and the manufacturers are constantly receiving numerous unsolicited testimonials, of which the following extract is characteristic: "We are using your compound all the time, and shall continue to do so, as we find it the best lubricant we have ever tried."

THE ABENDROTH & ROOT MANUFACTURING COMPANY, VICTORIOUS.—The damage suit instituted against the Abendroth & Root Company by the Philadelphia Edison Electric Light Company, alleging defective material and construction in a large number of Root boilers sold to the latter concern between 1889 and 1891, has been decided in favor of the defendants. It is stated by the boiler manufacturers that the evidence in the case showed that the trouble experienced by the electric light company with the Root boilers was due to exceptionally impure feed-water and excessive forcing of the boilers. A counter suit instituted by the Abendroth & Root Company for a balance due on the boilers was decided in its favor.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Dec. 5, 1895.

HORSELESS CARRIAGES.—There is quite a small agitation springing up in this country in favor of obtaining an act of Parliament which would permit of the use of mechanically propelled carriages on the high roads. Last week a paper was read before the Society of Arts on the subject, this week a

course of cantor lectures commenced at the same society's rooms, and on Dec. 10 a meeting of the "Self-Propelled Traffic Association" will take place at Cannon Street Hotel, with a view of passing resolutions in favor of legislative action.

THE BOARD OF TRADE DEFINITION OF "LOW PRESSURE."—The expert committee which, in accordance with the decision of Sir Courtnay Boyle (permanent secretary to the Board of Trade), at the recent conference, was to be appointed to advise the Board of Trade on the subject of altering the definition of "low pressure," consisted of Lord Kelvin, Mr. W. H. Preece and Major Cardew (electrical adviser to the Board of Trade). This committee, after several sittings, has, it is rumored, decided to advise the Board of Trade to raise the voltage to which "low pressure" regulations only shall apply to 500, although no more than 250 volts will be admitted inside the consumers' houses.

PRESIDENCY OF THE INSTITUTION OF ELECTRICAL ENGINEERS.—The opposition to the presidency of Sir David Salomons, which has generally showed itself, has resulted in his withdrawal, and the president for the year 1896 will be Dr. John Hopkinson. I understand that Sir David Salomons placed himself in the hands of Sir Benjamin Baker, president of the Institution of Civil Engineers, and Prof. A. B. W. Kennedy, president of the Institution of Mechanical Engineers, and abided by their advice. It is to be hoped that the members of the institution will not rest content with this victory, but will demand that the mode of electing Council should be radically altered, and that admission to the Institution of Electrical Engineers should not, as hitherto, be a pure matter of form. At present every one and any one can gain admission with little or no difficulty, and the election of Council, which is supposed to be in the hands of the members, is in reality in the hands of the Council itself. Every year the list of names for the new Council is sent out only a few days before the election takes place, no one knows beforehand who will be proposed, and no one in the short time allowed is able to organize a regular opposition to any individual. If the balloting papers were sent out at least three months beforehand, members of the Institution of Electrical Engineers might then, if they wished, have a voice in the election of Council.

LIQUID FUEL.—During the past year three of the English electric supply stations have been making experiments on the firing of boilers by means of liquid fuel, injected into the furnace on the Holden system. These stations are the Kensington, Knightsbridge, Sardinia Street and the Chelmsford stations. It is a remarkable coincidence that all three of these stations have been burnt down, although neither the origin nor the extension of the fire can be attributed to the liquid fuel. Indeed, an experienced engineer has stated that he would rather have tanks of liquid fuel in the midst of a fire than stores of coal. The experience which we have in the use of this fuel over here is very limited as compared with that of American engineers, who, no doubt, could tell us something to our profit in connection with the utilization of residuum, but so far we have found that firing in this way is no use as a mainstay for steam raising, but merely as an auxiliary to help the boilers over the awkward time they get for an hour or so every night when the heavy load comes on. Various fuels have been tried, including Russian astacki, tar, green-oil, creosote, etc.; tar has been found objectionable, and astacki is, as a rule, rather high in price, consequently it is now usual to mix a certain amount of astacki with any other heavy oil that can be bought cheaply at the time of purchase. As to the amount of forcing which it has been found can be obtained with liquid fuel, I may cite one example. Mr. Crompton experimented on a 700-hp Root's boiler and found that although 700 horse-power was about as much as he could get out of it with coal firing, yet with the addition of a couple of Holden liquid fuel injectors another 300 horse-power could be obtained almost immediately the injectors were turned on, and this without causing any injury to the boiler, or producing smoke.

General News.

NEW INCORPORATIONS.

THE CORRY STREET RAILWAY COMPANY, Corry, Pa., capital stock, $25,000, has been organized by G. W. Sill, Charles B. Ayers and S. I. Franklin, Warren, Pa., for the purpose of building an electric street railway.

THE BRONSON ELECTRIC LIGHT COMPANY, Bronson, Mich., has been formed by H. P. Mowry, J. S. Sheneman, J. F. Werner, Bronson, Mich.; William H. Bond, and C. F. Rhenbottom, Union City, Mich., to make and sell electricity. Capital stock, $10,000.

THE PITTSTON PEOPLE'S ELECTRIC STREET RAILWAY COMPANY, West Pittston, Pa., capital stock, $50,000, has been organized by James Flynn, Joseph C. Reap, Pittston, Pa., and Michael J. Langan, to construct an electric street railway.

THE CENTRAL TRACTION COMPANY, Sioux City, Ia., capital stock, $500,000, has been formed for the purpose of constructing electric light and power plants, street railways, etc. Those interested are Howard E. Baker, C. M. Ewan, George E. Morris, Sioux City, Ia.

THE PEOPLE'S ELECTRIC LIGHT, HEAT & POWER COMPANY, Avoca, Pa., capital stock, $18,000, has been formed to supply electric light, heat and power. The promoters are Patrick F. Joyce and C. F. Bohan, Pittston, Pa., and J. T. Lenohan, Wilkes Barre, Pa.

THE McKEES ROCKS ELECTRIC LIGHT COMPANY, McKees Rocks, Pa., has been formed to supply electric light, heat and power. The promoters are David Shaw, McKees Rocks, Pa.; Thomas S. Calhoon, Esplen, Pa., and Al. Young, McKees Rocks, Pa. Capital stock, $20,000.

THE SOUTH SIOUX CITY TRACTION COMPANY, South Sioux City, Neb., capital stock, $50,000, has been incorporated by T. L. Eaton, Henry J. Taylor, C A. Benton, D L Plumer and E H. Burgess for the purpose of maintaining and operating one or more street railways.

THE AKRON STREET RAILWAY & ILLUMINATING COMPANY, Akron, O., has been incorporated by J. B. Clews, J. A. Long, F. A. Sieberling, E. G. Gibson and Ira Miller, to acquire and operate a street railway to be run by electricity or other motive power. Capital stock, $1,500,000.

THE NATIONAL ELECTRIC CARBON & MANUFACTURING COMPANY, Portland, Me., capital stock, $500,000, has been incorporated by William A. Holmes, Harry S. Kimball and Charles F. Clark, Boston, Mass., for the purpose of manufacturing and dealing in carbon machines and carbons.

THE MUTUAL UNION INVESTMENT COMPANY, Elizabeth, N. J., capital stock, $100,000, has been formed to manufacture and furnish electric light and power for all purposes. Those interested are William S. Stryker, John W. Rehill, Somerville, N. J., and James P. Powers, Elizabeth, N. J.

THE NEW YORK GAS IMPROVEMENT COMPANY, New York City, N. Y., has been incorporated for the purpose of making and selling gas, electricity, etc. The promoters are Charles D. Lithgow, J. A. Snyder, E. J. Kavanaugh, P. F. Vaughan, New York City. Capital stock, $3000.

THE CITIZENS' AVOCA LIGHT, HEAT & POWER COMPANY, Avoca, Pa., capital stock, $20,000, has been formed by George McDonald, Scranton, Pa., George W. Milnes, Scranton, Pa., and John S. McGroarty, Wilkes Barre, Pa., for the purpose of furnishing electric light, heat and power, etc.

THE ASHLEY LIGHT, HEAT & POWER COMPANY, Ashley, Pa., capital stock, $50,000, has been formed by George McDonald, Scranton; George W. Milnes, Scranton, and John S. McGroarty, Wilkes Barre, Pa., for the purpose of furnishing electric light, heat and power in the borough of Sugar Notch' Pa.

THE UPPER ALTON WORKS, Chicago, Ill., has been incorporated with a capital stock of $2500, for the purpose of constructing waterworks, electric light, heat and power plants, and to generate and furnish electric light, heat and power. Those interested are George C. Morgan, Arthur M. Morgan and Henry A. Gardner.

THE OHIO LIGHT, HEAT & POWER COMPANY, Van Wert, O., capital stock, $10,000, has been formed by C. L. Marble, John E. Marble, George Haylor, Jr., O. D. Swartout and John B. Stevenson, Jr., for the purpose of manufacturing and selling gas and electrical current for light, heat and power, producing natural gas, etc.

THE PORT CHESTER ELECTRIC RAILWAY COMPANY, Port Chester, N. Y., capital stock, $500,000, has been incorporated for the purpose of building and operating a street surface road 10 miles long in West Chester County. The promoters are T. S. Krutz, C. H. Cummings, D. J. Pearsall and T. L. Cuyler, Jr., New York City.

THE PORT JERVIS ELECTRIC STREET RAILWAY COMPANY, Port Jervis, N. Y., capital stock, $7000, has been incorporated by S. D. Lake, A. G. Haines, and J. E. Wickham, Port Jervis, N. Y., and Lafe Pence, New York City, for the purpose of building and operating a street surface road seven miles long in Orange County.

THE SACRAMENTO NATURAL GAS COMPANY, Stockton, Cal., capital stock, $120,000, has been incorporated for the purpose of boring for gas, oil, and water, and manufacturing gas, oils, ice and electricity. Those interested are Jerome Hass, Henry C. Keyes, Thomas Quayle and John McCormick, of Stockton, Cal., and J. N. Jensen.

THE ELECTRIC RAILWAY HILL-CABLE COMPANY, San Francisco, Cal., capital stock, $1,000,000, has been formed for the purpose of constructing and repairing cable and electric railways and purchasing patent rights relating to railways. The promoters are N. W. Griswold, William H. Birch, and John L. Boone, San Francisco, Cal.

THE BROOKLYN BRIDGE, PROSPECT PARK & EASTERN RAILWAY COMPANY, Brooklyn, N. Y., has been organized by A. N. Brady, Albany, N. Y.; F. S. Flower, J. J. Kane and Edward Browne, New York City, for the purpose of building and operating a street surface road 44 miles long in Kings County. Capital stock, $500,000.

THE BROCKVILLE ELECTRIC STREET RAILWAY COMPANY, Brockville, Ont., capital stock, $200,000, has been formed for the purpose of constructing an electric railway which is permitted to extend a mile and a half beyond the town limits. Those interested are W. H. Comstock, W. A. Gilmore, C. A. Cossitt and G. M. Booth, all of Brockville, Ont.

THE MILNER ELECTRO-GRAVITATION MOTOR COMPANY, Charlestown, W. Va., has been incorporated by Wm. E. Conway, Silas H. Berry, James F. Atkinson and Thomas Hanson, Brooklyn, N. Y., for the purpose of manufacturing and dealing in motive power machinery and engines of all kinds, etc. Capital stock, $500 minimum, and $5,000,000 maximum.

THE CHARLESTON TRACTION, LIGHT & POWER COMPANY, Charleston, W. Va., capital stock, minimum, $500, maximum, $500,000, has been organized to purchase and own lines of street railway, water works, and any and all factories furnishing and selling water, electricity, etc. Those interested are W. A. MacCorkle, Malcolm Jackson, M. M. Williams, and A. W. Watrous, Charleston, W. Va.

THE CHARLESTON ELECTRIC RAILWAY & POWER COMPANY, Charleston, W. Va., has been incorporated by Neil Robinson, E. I. Buttrick, D. W. Patterson and E. H. Markell, Charleston, W. Va., for the purpose of owning and operating lines of street railway, plants, etc., and for furnishing water, electricity, gas and other illuminating substances, motive power, etc. Capital stock, minimum, $500; maximum, $500,000.

THE ORANGE MOUNTAIN TRACTION COMPANY, West Orange, N. J., capital stock, $150,000, has been formed to purchase and take over the property and franchise of the Orange Mountain Cable Company, a corporation organized under the laws of New Jersey. Those interested are Walter C. MacFarland, 142 South Fourth Street, Philadelphia; Wm. S. Hood, 607 North Second Street, Camden, N. J., and Leonard C. Dodge, 2236 Mt. Vernon Street, Philadelphia.

THE BOYNTON BICYCLE TRACTION COMPANY OF SPAIN, New York, N. Y., has been incorporated in West Virginia with a capital stock of $10,000 minimum, maximum, $5,000,000, for the purpose of acquiring letters patent for appliances, devices, etc., for generating light, heat and power by electricity, steam, etc., and to construct railways. Those interested are Jose F. de Navarro, Thomas E. Sotolongo, Mariano de Cossio and George R. Cullingworth, New York City.

ELECTRIC LIGHT AND POWER.

DECATUR, ILL.—The Council has decided to purchase a 60-arc light dynamo.

NEW CASTLE, COL.—The town board has resolved to have an electric light plant of 1000 lights capacity.

GREENWICH, O.—Plans and specifications have been prepared for the construction of a water and light plant.

ATLANTA, IND.—Capital stock has been subscribed for the organization of an electric light plant at Atlanta of 50 lights capacity.

ELIZABETH, N. J.—City Clerk Manning is instructed to advertise for bids to furnish the city with 750 incandescent and 50 arc lamps.

PRICEBURG, PA.—Ground has been broken for the new electric plant. The main structure will be 60 x 30 feet with an annex 22 x 30 feet.

SHARON HILL, PA.—The contract to light the borough by electricity has been awarded to the Citizens' Electric Light Company, of Clifton.

SHELDON, ILL.—G. W. Songer, proprietor of the Cissna Park Electric Light Plant, is considering the matter of establishing a plant at Sheldon.

LONDON, O.—The Council has adopted plans and specifications prepared by the engineer for the proposed new electric light plant. Cost not to exceed $15,000.

SOMONAUK, ILL.—The City Council of Somonauk has given a franchise to a company to put in an electric light plant. The city clerk can furnish particulars.

DAVENPORT, IA.—The time for receiving bids for the city lighting has been extended from Dec. 3 to Dec. 31. F. W. Boynton is Commissioner of Public Works.

SHARON HILL, PA.—The Council of Sharon Hill has passed third reading an ordinance relating to the issuing of a contract for lighting of the village with electricity.

BUFFALO, N. Y.—A bachelor apartment house to be erected on Delaware Avenue by Albert C. Spann and Ralph A. Kellogg will be provided with an electric elevator.

ELIZABETH, N. J.—The Mutual Investment Company has been organized in Elizabeth for the purpose of placing electric light plants, railways, etc., in Mexico and Central America.

NEW CASTLE, COL.—The town has passed a resolution declaring the need of an electric light plant. Samuel Wraith is chairman of the committee to secure information as to cost.

CHICAGO, ILL.—The West Park Commissioners, Union Park, will erect a one-story and basement brick and stone station building, 64 x 163 at Garfield Park, for an electric light plant.

LEXINGTON, KY.—The Joint Committee on Lights has recommended that the Council authorize the Mayor to advertise for bids on the cost of erecting a plant to be operated by the city.

WHITESTONE, L. I., N. Y.—Now that the street-lighting contract in Whitestone has expired, the citizens are discussing the feasibility of introducing electric lights in the village.

BUCHANAN, MICH.—The Buchanan water-power, dam and equipments, rights, franchises, etc., of the Electric Light & Power Company will be sold under order of the Circuit Court on Jan. 17.

MARQUETTE, MICH.—The City Council has resolved to appropriate for the use of the light and power commission the sum of $4000 to purchase the necessary machinery for the improvement of the plant.

RIDLEY PARK, PA.—Ridley Park intends to own its own light, heat and power plant, and a charter for the intended incorporation is to be applied for. R. S. Pomeroy, Charles G. Darrach, Job Smith, Wendell P. Anthony and Henry H. Taylor are the parties at the head of the movement.

ASHLEY, PA.—Charters have been granted at Harrisburg to the Ashley Light, Heat & Power Company, the Sugar Notch Light, Heat & Power Company, the Warrior Run Light, Heat & Power Company and to the Citizens' Avoca Light, Heat & Power Company, all of Luzerne County.

TOPEKA, KAN.—The Council Committee on Lights has reported it advisable to purchase three 100-light dynamos and 250 lamps. The improvements in the plant will require about 10 miles of new wire, and the city engineer will make surveys to determine just how much wire and how many poles will be necessary.

BATH, N. Y.—James H. Paul and Wm. Walker, of Carbondale, Pa., representatives of a Pennsylvanian syndicate, desire to purchase the plant of the Bath Electric Light & Power Company. Before doing so they want some assurance from the village board that if they buy the plant and duplicate it throughout, that they will have an extension of the franchise for 45 years.

COLLEGE POINT, L. I., N. Y.—There is a possibility that the village of College Point will be lighted by electricity soon. An electric plant is being constructed in the old Peck Mill at Flushing, which when completed will furnish electric lights to all parts of the town. It is said that when the contract of the College Point Gas Company expires the village trustees will enter into negotiations to have the village lighted by electricity.

THE ELECTRIC RAILWAY.

OWASSO, MICH.—G. M. Edwards has the contract to build the car-house for the electric railway company.

HOLMESBURG, PA.—The Holmesburg, Tacony & Frankfort Electric Railway Company will extend its line to Trenton, N. J.

MONTICELLO, N. Y.—Monticello, White Lake & Neversink Valley Traction Company will probably be the name of the proposed new electric road.

RED BANK, N. J.—The application of the trolley company for right to build its road on Shrewsbury Avenue to the Rinton Falls Road has been granted.

MARLBOROUGH, N. Y.—It is proposed to build a trolley road from Marlborough to Newburgh, to be called the Newburgh Electric Railway Company.

SAN BERNARDINA, CAL.—It is reported that the Santa Fe Railway Company is backing a project to convert the E Street road into an electric line.

KNOXVILLE, TENN.—An ordinance has been passed granting a franchise to the Citizens' Railway Company to extend its line in four directions.

VICKSBURG, MISS.—The Vicksburg Electric Transit & Light Company is in the market for two 125-hp generators, two 150-hp high-speed engines, and five motor cars.

SALEM, O.—The consolidation of the Salem Power & Light Company and the Salem Electric Railway Company is being considered by the stockholders of the two concerns.

SEWICKLEY, PA.—The Coraopolis, Sewickley & Economy Street Railway Company and the Ohio Valley Street Railway Company are making efforts to obtain right of way in this place.

BUFFALO, N. Y.—The Cross-Town Street Railway Company has made application for permission to extend its lines, and the Buffalo Traction Company has made a similar application.

BATH, N. Y.—The Corning & Painted Post Electric Railway Company will probably build a road from Bath to Hammondsport. The manager of the company is C. W. Prince, Corning, N. Y.

HOLYOKE, MASS.—The Holyoke Street Railway Company, is making repairs and changes in its line to Chicopee Falls, and is considering the matter of extending the line to South Hadley.

KANSAS CITY, MO.—An ordinance was introduced in the Council recently providing for the grant of a franchise to the West Side Railway Company for an electric railway on Wyandotte Street.

CINCINNATI, O.—The Consolidated Street Railway Company has been granted permission by the Board of Alderman to put up trolley wires. This does away with the last horse-car line in this city.

PLATTSBURGH, N. Y.—T. F. Conroy, of Plattsburgh, has purchased Ausable Chasm, including hotel and about 500 acres. It is expected that a trolley system will be built from Plattsburgh to the Chasm.

MILFORD, MASS.—The new power-house of the electric road will be a fireproof brick building, 42 x 80, with a 75-foot brick chimney, and will contain two 200-hp engines and a corresponding electrical equipment.

MILLEDGEVILLE, GA.—The old Capital Railway Company is to be reorganized. It is said a sale of the road will be made, a new company formed, and the road will be rebuilt and put in first-class condition.

MIDDLETOWN, CONN.—An electric railway will probably be built by the New York, New Haven & Hartford Railway Company from Cromwell to Middletown, to connect with the Meriden & Cromwell Railway.

AKRON, O.—The Akron & Cuyahoga Falls Rapid Transit Company has been granted a franchise for an electric railway between Barbertown and Hametown. Thomas F. Walsh is manager of the company.

WESTFIELD, MASS.—The 41 shares of additional stock of the Woronoco Street Railway, authorized by the state railway to be issued for extending the line, and equipping it with electricity, was sold at auction recently, as required by law.

SAN RAFAEL, CAL.—S. B. Cushing is interested in the Tamaltis Mountain Railway, to be built from Hill Valley to the summit of the mountain, a distance of about seven miles. The grade is about seven per cent. The engineer in charge is G. B. Avery, San Rafael.

PORT RICHMOND, S. I., N. Y.—Port Richmond Trustees have granted the franchise on Richmond Avenue to the Staten Island Electric Company, under condition that the Midland Company should have common trackage over the short line from Jewett Avenue to the Bergen Point Ferry.

WASHINGTON, D. C.—The Washington & Mount Vernon Railway Company began the work of laying tracks for the entrance of its lines into Washington this week, and the work is to be completed by the first of January, 1896. Arrangements have been made with the Pennsylvania road, by which the Mount Vernon road is to enter the city by way of the Long bridge.

WASHINGTON, D. C.—The Capital Traction Company has had a bill introduced in the Senate to amend the company's charter, so as to permit an extension from Seventeenth Street and Pennsylvania Avenue along G Street to the river, and return track by way of F street to Seventeenth Street. Also to run along Twenty-second street, between the river and Florida Avenue.

PRINCETON, IND.—It is reported that the Princeton Interurban Electric Railway Company has been granted a 20-year franchise by the City Council. The company is composed of citizens of Princeton and capitalists of St. Louis, Chicago and Louisville, and it is said that an electric street car-system will be put in in Princeton within the coming year, and that other lines will ultimately be built to neighboring towns.

WINDSOR LOCKS, CONN.—The Windsor & Suffield Tramway Company will build its projected electric railway to either Rainbow or Poquonock, at a cost of $30,000. This company was incorporated in 1893, with a capital stock of $50,000, and among the parties interested are David Henney, president of the Hartford & West Hartford Horse Railway Company, Framington, Conn.; H. C. Douglas, Windsor Lock, and Wm. R. Hurd, Bristol, Conn.

PORTLAND, ME.—The Portland & Cape Elizabeth Railway Company has filed at the city clerk's office a trust mortgage on its property to cover an issue of $400,000 worth of bonds, to be dated Nov. 1, 1895, and to bear 5 per cent. interest. The provisions are that $250,000 worth of bonds shall be at once placed at the disposal of the company; $50,000 shall be delivered from time to

time, and $100,000 shall be delivered when the company has 15 miles of track in operation. The company is now ready to operate a road between Cape Elizabeth and Portland.

Trade and Industrial Notes.

WARREN WEBSTER & CO., Camden, N. J., are distributing some attractive advertising blotters, which should serve to keep their vacuum system of exhaust steam heating constantly before the members of the trade. The firm has issued a pamphlet supplementary to the regular catalogue, and describing some interesting and important improvements which have been added to the system.

THE IMPROVED HUNNINGS TELEPHONE and switchboard, manufactured by the Electric Appliance Company, Chicago, continues to hold its ground, it is said, as one of the thoroughly satisfactory outfits on the market. The telephone itself has been improved from time to time, and the switchboard has by no means been neglected. It is claimed by the manufacturers that this board is operated more easily and with a less number of movements than the regular exchange board.

AN OPPORTUNITY to purchase an electric light plant advantageously will soon be afforded by the Michigan Trust Company, receiver for the Buchanan Power & Electric Company, of Buchanan, Mich. An order has been made by the court directing the receiver to sell the property and assets of the company at public auction, at Buchanan, on Jan. 17, 1896. The plant comprises one 60-light arc dynamo, one 60-hp power generator, one 1250-light alternator, about 24 miles of copper wire, poles, power-house, turbines, wheels, shafting, etc., together with franchises, real estate, etc.

A VISIT to the works of the Ball Engine Company, Erie, Pa., impresses one with the idea that prosperous times have certainly returned. Every department of this very complete establishment seems to be crowded with work; in fact, the shops have been running nights since last June. The erecting floors are crowded with many engines in various stages of construction, among them especially noticeable being the large number of engines arranged for direct-connection to dynamos, and it is stated that a large proportion of the engines built by this company at the present time are of that style. It is a significant fact that for the past four years every engine turned out of the Ball Company's works was used for electric power transmission in some form or other. Among the engines now in process of construction are one 400-hp horizontal side-crank engine, arranged for direct-connection, being the first of three for the Apollo Iron and Steel Works, at Vandergrift, Pa.; one 350-hp engine for the Edison Electric Company, of New Orleans; a 300-hp vertical compound for the Los Angeles (Cal.) Street Railway; and a number of engines for the Troy Iron & Steel Company, Troy, N. Y.; Mabley Building, Detroit, Mich., and other parties in various parts of the country. The company states that there are sufficient orders in hand to keep the works busy for several months to come, and reports an unusual number of inquiries for this time of the year.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 10, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

550,941. BOND OR CONNECTOR; Adolph G. Carlson, Chicago, Ill. App. filed July 13, 1895. A rail bond having enlarged ends, a rivet or stud on the circumference of which said cone-shaped shoulder terminates, and a cone-shaped end of said rivets or studs, said bond being adapted to be riveted in suitable holes in the ends of electrical conductors. (See Illustration.)

550,956. CARBON HOLDER FOR ARC LAMPS; Hugh J. Farley, Philadelphia, Pa. App. filed Dec. 15, 1894. In an arc light holder, a removable casing formed in separate sections, the body portion having an interior flange, threaded to receive the outer casing, which is formed in two parts with a spherical cavity to receive the rod of the lamp, and a ring nut having a series of spring fingers, adapted to be secured to the lower end of the body of the holder.

550,959. ELECTRIC CLOCK; B. Franklin, Chicago, Ill. App. filed April 1, 1893. The combination in an electric clock, of a train, a driving-wheel therefor, a pendulum in operative connection with said driving-wheel, an impulse-lever, means for bringing the latter into connection with the pendulum when the arc of vibration thereof is shortened below a given limit, an impulse-arm for acting said impulse-lever, means for holding said arm in a normal position, means, in operative connection with said impulse-lever, for releasing the impulse-arm, a source of electricity, a normally open circuit, a circuit making and breaking device, and an electromagnet, the armature of which is in operative connection with said impulse-arm.

550,965. ELECTRICAL CONDUIT RAILWAY; John D. Griffin, New York, N. Y. App. filed December 5, 1892. The combination with a conduit, having the usual slot, the trolley wire and the trolley arm, of a carriage for the trolley arm; rollers in said carriage adapted to engage the sides of the slot; ball boxes in which said rollers are journaled, and which are provided with hubs, and springs engaging said hubs, and acting to hold the rollers in contact with the sides of the slot with a yielding pressure.

550,982. HARMONIC SELECTIVE SIGNAL FOR PARTY TELEPHONE LINES; James A. Lighthipe, San Francisco, Cal. App. filed June 24, 1895. The combination with a source of electricity of an electromagnet provided with two opposed windings, said windings being included in parallel paths of the circuit, a reed adapted to vibrate in front of the pole of said electromagnet, and contact points controlled by the vibration of said reed for intermittently opening and closing the circuit through one of said windings.

551,020. ELECTROMAGNET; Samuel T. Wellman, Upland, Pa. App. filed April 18, 1894. The combination in a magnet for lifting plates, etc., of the cores, the top plate, a non-magnetic bottom plate through which the cores of the magnet pass, and a shell surrounding the coils of the magnet.

551,021. ELECTRIC RAIL-BOND; William H. Wiggins, Worcester, Mass. App. filed May 22, 1895. A conical sleeve is used to hold the end of the bond in the rail.

551,029. ELECTRO ARC LAMP; William J. Davy, London, England. App. filed April 19, 1895. In an electric arc lamp in which the carbon holders are connected together by a flexible connection passing over a pulley, and in which the carbons tend to approach, the friction grip device consisting of two parallel nipping surfaces, and pivoted parallel to the nipping surfaces a means for determining the position of the lever pivot according to the resistance of the arc, and a stop on which the notched end of the lever rests.

551,032. CLEAT FOR ELECTRIC WIRING; James R. Hemphill, Akron, O. App. filed Sept. 26, 1895. As a new article of manufacture, a cleat for electric wiring, having a wire receiver tapered or reduced in width towards its inner end, and having one of its walls dented so as to hold a wire. (See Illustration.)

551,033. COMMUTATOR BRUSH; Robert and Herman Meminger, Milwaukee, Wis. A commutator brush composed of alternating strips or sections of carbon or a carboniferous composition, and strips or sections of metal offset or inclined to the plane of rotation of the commutator, so as to present thereto a continuous and approximately uniform area of metallic contact.

551,046. ELECTRIC ARC LAMP; Frederick N. Pike, New York, N. Y. App. filed June 27, 1894. In an arc lamp, the combination of an arm comprising a longitudinal portion and a transversely extending portion, a carbon support secured to the transversely extending portion, a carbon support movable lengthwise of the longitudinal portion of the arm, a screw engaging with a nut supported by the second carbon support, ratchet wheels secured to the end portion of the screw, solenoids whose cores are provided with pawls for actuating the ratchet wheels, and means for producing a vibratory movement of the cores to actuate the screw.

551,053. ELECTRIC CONTROLLER; Sidney H. Short, Cleveland, O. App. filed Aug. 26, 1895. In an electric controller, the combination with a series of rotary contacts made of magnet material and a series of magnet poles arranged with relation to said contacts, whereby a complete magnet circuit comprises two of said magnet poles and two of said contacts and contact fingers, having their free ends located within the magnetic fields thus produced.

551,054. ELECTRIC CONTROLLER; Sidney H. Short, Cleveland, O. App. filed Aug. 27, 1895. The combination with a series of iron sleeves provided with segmental contacts, of an electromagnet having its pole arranged in close proximity to the path of travel of said contacts, and a series of contact fingers the free ends of which are arranged to engage said segmental contacts.

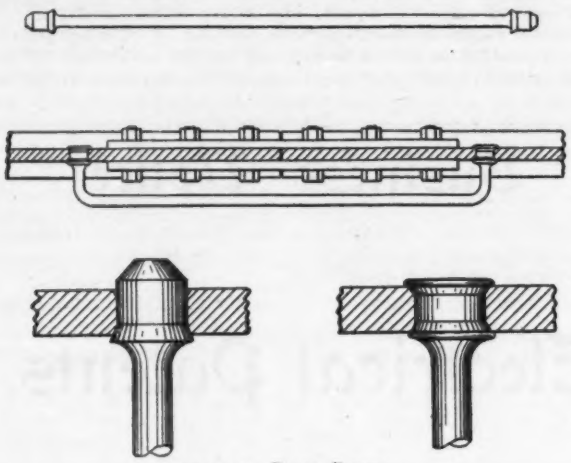
551,056. MULTIPLE SWITCHBOARD SYSTEM; Theodore Spencer, Cambridge, Mass., and Thomas C. Wales, Jr., Boston, Mass. App. filed March 18, 1895. Two telephone circuits, each extending from a sub-station to the same central station, and completed or closed through a section of conductor common to both, which common conductor includes an electrical generator, and a repeating coil having two sections respectively interposed between the opposite poles of said generator and the two conductors of the said circuits, each section having one of its windings included in each of the said two circuits, respectively.

551,060. TELEPHONE CIRCUIT; John S. Stone, Boston, Mass. App. filed July 6, 1895. In a centralized battery telephone system, the combination with two main line conductors extending to a sub-station, forming severally the two conductors of a metallic talking circuit, connected in parallel with one another to constitute the single line conductor to a support circuit, having a ground or independent return conductor, and containing the main source of current supply; of a retardation or impedance coil having its two ends united to the two sub-station ends of the said main conductors, and its middle to their common earth terminal or return conductor, the sub-station transmitter connected in said terminal conductor, and two electrolytic or polarization batteries connected in independent shunt circuits extending from different sides of the said transmitter to the two main conductors respectively.

551,090. SIGNALING APPARATUS; Bernice J. Noyes, Boston, Mass. App. filed Sept. 11, 1889. A multiple signal transmitter, a pointer, and switch moved by the pointer, and a retarding device which is operatively connected therewith in certain positions only, combined with a signal-receiving apparatus connected with the multiple signal transmitter by an electric circuit, said signal-receiving apparatus comprising a register and a bell.

551,123. SUCCESSIVE NON-INTERFERING SIGNAL BOX; William H. Kirnan, Brooklyn, N. Y. App. filed Aug. 18, 1890. The combination in a signal transmitter, of a circuit controller, a normally wound motor therefor, a releasing device for the motor, a magnet in the signal circuit at the transmitter, a normal short circuit for the magnet, and a circuit-breaker operated by the first movement of the transmitter.

551,145. SWITCH FOR UNDERGROUND ELECTRIC RAILWAYS; Alfred Rosenholz, San Francisco, Cal. App. filed April 12, 1895. A distributing switch for electric conduits, consisting of a magnetic core or conductor projecting from the main conductor, a sealed casing therefor fulcrumed and turnable about the main conductor, journals or bearings upon which the casing is movable, a flexible insulating sheath or jacket inclosing the conductor and core, and an exterior filling or packing surrounding the sheath.



550,941—Rail Bond.

551,166. JOINT FOR INSULATED ELECTRIC WIRES; Raymond S. Kelsch, Chicago, Ill. App. filed Dec. 22, 1894. An attachable and detachable joint for electric conductors, comprising, in combination, a coupling consisting of an externally threaded sleeve provided with a jam-nut and a sleeve provided with a swiveled nut to receive the externally threaded sleeve and be engaged by the jam-nut to clamp the parts securely together, the sleeves having flaring openings through them to receive and hold in contact the flared and jointed ends of conductor sections, and an envelope for the coupling, comprising separable box members with means for securing them together, affording a chamber for insulating material and fitting at its ends the conductor sections.

551,168. TROLLEY; David Lippy, Ira Elmer Finfrock, George Attigg Rinehart, and David Raitt Francis, Mansfield, O. App. filed Sept. 24, 1895. The combination of the pivoted mast, the two parallel rods, the two bars slidingly mounted upon the rods, connections between the bars and mast, and coiled springs on the rods engaging the bars.

551,169. TROLLEY; David Lippy, Ira Elmer Finfrock, George Attigg Rinehart, and David Raitt Francis, Mansfield, O. App. filed Sept. 24, 1895. The combination of the pivoted mast, a shaft having two radial arms, connected with the mast, and a coiled spring for rotating the shaft.

551,170. SWITCH FOR ELECTRIC PLANTS; Austin H. Lucas, Pittsburg, Pa. App. filed Jan. 4, 1895. A switchboard having in combination a series of pairs of contacts arranged in line and adapted to be connected to a like series of generators, a second series of pairs of contacts arranged parallel with the first series, a shaft or rod arranged parallel with said series of contacts, and provided with a longitudinal groove and with a series of transverse grooves, a pair of arms having one end mounted on said shaft or rod and each having a pin or key adapted to fit said grooves, the transverse grooves being arranged so as to permit of a rotation of the arms on the shaft only when the arms are in line with a pair of contacts.

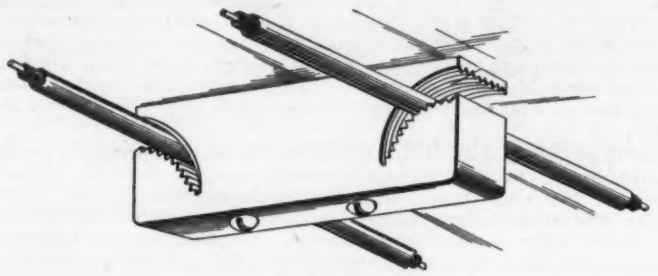
551,192. TELEGRAPH RELAY; Archibald David McDonald, Melbourne, Victoria. App. filed Nov. 2, 1894. In a relay, the combination with an electromagnet of a lever fulcrumed at one side of said magnet, and having on one side of its fulcrum in successive order, an armature, contact points and a tension spring, the latter vertically set above the end of said lever, and on the other side of said fulcrum an arm or extension of such weight as to act as a counterpoise to the first named side of the lever, and allow the latter to rise against the back stop when the said spring is regulated to exert an upward pull. (See Illustration.)

551,203. ELECTRIC SWITCH; John E. Criggal, Springfield, Mass. App. filed Jan. 15, 1895. In an electric switch, the combination with a supporting base of a circuit-controller movable with the actuating member, and pivotally mounted on said base; a spring between said circuit-controller and the base, and normally held under compression by the circuit-controller; and an actuating member pivoted on said base for closing the circuit controller, and normally holding said circuit-controller against free, reactive movement, and adapted to release the same, at a predetermined point in the backward movement of the actuating member, whereby said circuit-controller has a sudden and multiplied releasing movement, in the direction and independent of such movement of the actuating member.

551,230. COMPOSITION OF MATTER FOR INSULATING PURPOSES; Rufus N. Pratt, Hartford, Conn. App. filed Oct. 31, 1889. An electrical insulating composition consisting of dense hard rubber, laminated mica, and fibrous asbestos, combined as specified.

551,244. ELECTRIC ARC LAMP; William P. Wiemann, Washington, Pa. App. filed April 17, 1895. In an arc lamp, the combination with the rod controlling mechanism, of a releasing point therefor, and means for automatically changing its position as the carbon decreases in weight.

551,263. ANTI-SPARKLE COMMUTATOR COMPOUND; John R. Davis, New Iberia, La. App. filed March 30, 1895. The compound containing a fatty substance, a good conductor of electricity mixed with said substance, and chalk to harden the mixture.



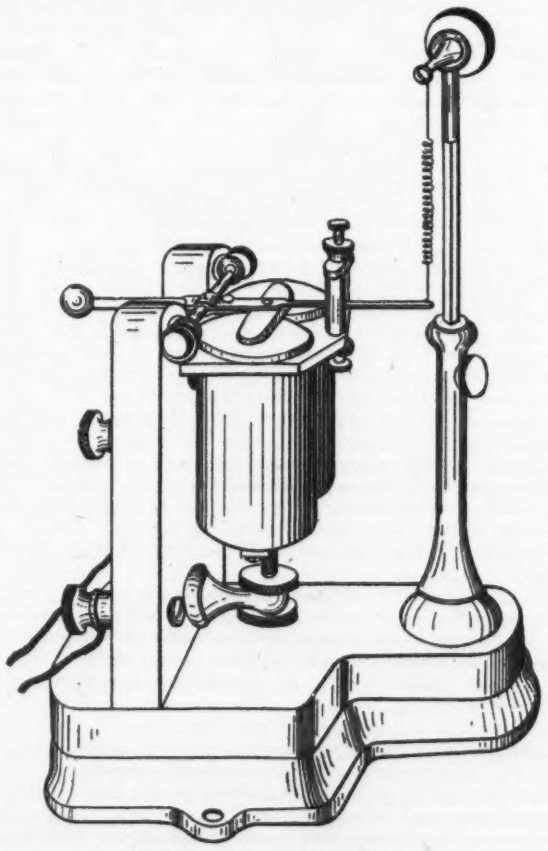
551,032.—Cleat.

551,275. TELEPHONE TRANSMITTER; John Goodman and Henry M. Goodman, Louisville, Ky. A telephone transmitter consisting essentially of two magnets, the one fixed or relatively so, and the other capable of vibration, said magnets being so collocated and mechanically adjusted that the movable magnet in its vibrations at all times remains equi-distant from the adjacent parts of the stationary magnet, a vibrating diaphragm to which the vibratory magnet is mechanically connected or related, and finely comminuted magnetic material between the two magnets in the magnetic field formed thereby.

551,284. ELECTRIC SUNSHINE ANNUNCIATOR; Leonard Hunt and Frederick W. Duenckel, St. Louis, Mo. App. filed May 20, 1895. An electric sunshine annunciator, comprising a pair of balanced bulbs partially filled with liquid, tubes connecting the lower ends of said bulbs, a block fixed to the longitudinal centre of said tubes, a screw mounted in the upper end of said block, a knife-edged plate carried by said screw and passing through a slot in the upper end of said block, and uprights upon which said knife-edged plate engages.

551,334. ELECTRIC RAILWAY; Robert Lundell, Brooklyn, N. Y. App. filed June 9, 1894. An electric railway provided with an electric feeder or main, branch feeders running therefrom to switches controlled by electromagnets; sectional trolley conductors arranged in pairs and connected one of each pair to its own switch-operating magnet, and the other to the same magnet and to the next adjacent magnet.

551,337. ELECTRODE FOR ARC LAMPS; Thomas G. Portis, St. Louis, Mo. App. filed May 14, 1895. A pair of electrodes of an arc lamp, having their arc ends lightly coated and their outer ends heavily coated.



551,192.—Telegraph Relay.

551,347. TELEPHONE RECEIVER; Alfred Charles Brown, London, England. App. filed July 11, 1895. The combination of a battery transmitter, a telephone receiver having a diaphragm, and buzzer contact to be operated by said diaphragm, a battery, and a switch for closing the connection of the battery through the transmitter or through the buzzer contacts and a coil of said receiver at will.